THE

ELECTRICAL REVIEW.

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THE

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THE COST OF MUNICIPAL ENTERPRISE.

THE discussion on Mr. Dixon Davies's paper on the above subject before the Society of Arts was continued and concluded on Thursday last week. That the subject is arousing something more than a mere trade interest is evidenced by the fact that political lights such as the Attorney-General and Mr. John Burns—men of very opposite schools—thought it worth their while to take a prominent part in the debate. In truth, the issue raised by Mr. Dixon Davies is more far reaching than is realised by those who think that because the field of electrical engineering happens to be that in which the campaign has opened, the struggle is therefore narrowed or likely to be hereafter confined to its boundaries.

Dismissing the views of the fanatics at the two extremes of thought—those who contend that municipalism can do no wrong, and the others who hold it and all its works accursed—we are brought to the standpoint of the average man. As he is neither a municipal official on the one hand, nor a rapacious capitalist on the other, he will probably recognise that municipalism has its sphere—and its limitations. It is the borderland between these two that is the scene and cause of antagonism between the two schools—the individualists who follow Mr. Davies, and the collectivists whose cause Mr. Burns passionately championed.

That victory must, in the end, rest with the side of public advantage, irrespective of theoretical considerations, is obvious. It is the reduction of this formula to practice, its correct application to the inflamed organisms which periodically manifest themselves in the body politic, that is the difficulty.

Mr. Davies furnished figures which we will not now repeat. Suffice it to say that they carried conviction to the mind of the Attorney-General. Mr. John Burns's reply to them was characteristic:—"Gentlemen, we are told that figures cannot lie; but liars can figure."

We will not do the cause of municipalism the injustice to suggest that this witty—we were going to misname it argument, but substitute epigram—is its best effort to rebut Mr. Davies's conclusions; but we do say that it is at least unfortunate that the advocates of municipalisation produced no spokesman who said anything as good, or more convincing. In response to those who point to the application this session of 70 local authorities to secure powers to manufacture electrical plant and accessories, an electrical contemporary, which we suppose claims to represent the municipalisers' case, suggests that the empowering clause is merely a piece of irresponsible Parliamentary draughtmanship, for the purpose of gathering in wider powers than the local authorities have any intention of putting into practice. This ingenious disclaimer will not bear investigation in the face of such facts as that the hard-

D [illegible]

ware trades of a number of northern towns are at this moment complaining bitterly because their Councils, led on by the permanent officials, are undertaking the manufacture of gas stoves, meters, &c., that the Battersea Vestry has just resolved to establish its own printing and binding works, and similar cases in point of daily occurrence. Recent resolutions adopted by the Manchester, Liverpool, and other Town Councils in reference to the private Electrical Power Distribution Bills before Parliament, state clearly the corollary to the grant of powers to local authorities to manufacture and trade—namely, that any undertaking by a local authority shall thenceforward be held sacred from competition by anyone else within their area. "Local authorities should be encouraged to undertake and monopolise every trade and business that they can make pay"—this is the gospel according to St. John Burns, delivered with perfect frankness and sincerity at the Society of Arts last week.

Again, we say the question is one of social expediency and not of *à priori* assertion. The municipalist view may be the correct one, as most consistent with the advantage of the majority. We, ourselves, honestly doubt this, but that is not the point. Evidence is wanted to throw light upon the subject from all points of view, and before the best and most independent tribunal our social arrangements can offer. This tribunal is undoubtedly in a democratic country, that of public opinion, expressed through its chosen representatives in Parliament.

A wave of public opinion is gathering that the whole question of the sphere, scope, and limitations of municipal enterprise should be again considered by a Royal Commission or Joint Committee of the two Houses. The remarkable, and, in many respects, admirable, development of municipal enterprise since the Legislature last dealt with the problem, will furnish ample material for examination, analysis, and formation of sound opinion as to whether the nation should go forward, call a halt, or in any measure retrace its steps on its march of civic life.

We regard it as our duty to strongly support this growing body of public opinion, and would go further and urge local authorities to join with those who differ from their view in bringing about the appointment of a commission or joint committee, as suggested.

The public are equally interested whether as ratepayers, consumers, or private traders, and it is in every sense to their advantage, through the representatives of their civic life, that a policy and guide for future action should be laid down upon this important issue.

Trials of Telephonic Apparatus.

Experiments with new forms of telephonic apparatus, the results of which are duly published in the prospectuses of exploiters of the same, are often extremely misleading to the public, and also, we should add, to the experimenters themselves. We have, for instance, a statement that such and such a telephone has worked with great success through a length of 2,000 miles of wire, which to the public seems a marvellously good result when they are ignorant of the fact that a very bad telephone would work equally well through 5,000 miles if the wire were of a sufficiently large gauge. The all-important element of gauge, in fact, being left out makes the test practically valueless for indicating the true value of the instrument. Again, the (what ought to be) well-known erroneous method of testing through a looped wire with the transmitter and receiver at the same end of the loop, and without using earth, is by no means knocked on the head, it is often quoted as being a severe test when it is actually perfectly useless. Tests through artificial cables also are by no means to be relied upon, these cables may be perfect as regards their K and their R, and may be entirely satisfactory for experiments on telegraphing through cables, but for telephonic experiments they are not to be relied upon, as there is often a reaction between the bobbins of which the resistances are composed, which, for telephonic purposes, practically cuts down the effective length of the cable to a very marked extent. In fact, we are actually working through K R diminished by inductive reaction, this reaction being by no means an inconsiderable quantity. The only test of real value is to pit one telephonic instrument against another through the same artificial cable, and determine which is the best of the two by adding in resistance and capacity until one of the two on trial commences to fail. We have seen this done on more than one occasion to the complete discomfiture of the vaunted improvement.

The Barking Explosion.

At the adjourned inquest on this explosion at Messrs. Hewett's Works, nothing much further transpired than had previously been reported. The works manager spoke to the overhaul of the safety valve in March, 1897, and the boiler had been unused since that date. The finding of the jury is extremely unsatisfactory, though probably as good as they could manage in the absence of better information. Without all details it is not possible to formulate a theory of the explosion of great value, but we cannot but think that it was due to the over-pressure caused by repeated screwing down of the safety valve. A very little screwing down is sufficient to account for a very considerable accession of pressure. Such screwing down, in the absence of ferrules on the spring balances, may absolutely lock the safety valves. Such screwing down we assume to have been done because the pressure gauge moved up so slowly, and there had been too many changes about in the men who were attending the boiler for proper suspicion to arise as to the slow generation of steam with so large an amount of fuel used. The gauge evidently was relied upon as accurate. Now it ought to be known—it cannot be too well known—that the passages leading to pressure gauges are only small and are very easily closed by the use of a compressible joint washer of lead. The lead washer is a most dangerous appliance, especially when thick. Such small joint washers ought to be thin and pierced with a hole much larger than the hole in the pipes they connect. Again we believe that it has been known for gauge manufacturers to send out gauges in which, for the sake of preventing shake in transit the Bourdon tube is held by a piece of packing inserted between the case and the tube. The effect of this is to prevent or reduce the movement of the tube. The practice is most dangerous, and steam users would do well to ask for gauges in which the working parts are fully visible from the front, the face being of glass, not of metal. The coroner relied upon the expert evidence as proving that the explosion could not have been caused by so low a pressure as the 16 lbs. shown by the gauge. Unfortunately, the most careful inspection by skilled inspectors could not be of much avail in such a case as this, though had the boiler been previously under inspection it is probable there would have been ferrules on the spring balances, and these could not have been screwed past their proper position, and suspicion would then have been awakened as to the defective pressure gauge. The Barking explosion, in short, appears to have been due to a peculiarly fortuitous assemblage of causes comparatively trivial in themselves, and it adds one more proof to the necessity of carefulness in details and duplication of safeguards. The verdict of the jury did not include any charge of culpable negligence against anyone, though they considered the boiler had been insufficiently examined, and there had been remissness in its preparation, and a want of adequate supervision. They were also of opinion that all boilers should be independently examined by qualified inspectors at stated periods.

ELECTRIC GONG BUOYS.

The *Canadian Electrical News* for October, 1898, contains an interesting and instructive article describing a system of electric signal buoys which has been devised by Mr. F. A. Hamilton, E.E., for the purpose of facilitating the navigation of vessels on approaching land in thick and foggy weather.

The article is a *résumé* of a paper read by its author at the first convention of the Maritime Electrical Association on September 27th, 1898, which, after some preliminary remarks, emphasising the advantages of this method of giving indication of the position of a vessel on her approaching narrow waters, gives a somewhat detailed description of the system generally.

A tribute of praise is accorded the "whistling," or what is commonly known as Courtney's automatic buoy; but it is pointed out that something more in the way of a signalling buoy is desirable to enable mariners to keep clear of outlying dangers, especially in vicinity of harbours on the coast of North America. The whistling buoy, it would appear, must necessarily be moored in shallow water, consequently, in most cases, it would be near the shore, so that with the wind blowing towards the land, a vessel must pass inside the buoy in order to "pick up" the sound of the whistle.

The author cites the approaches to Halifax harbour as a typical case. He says: "An automatic buoy is moored on the Outer Bank, 5 miles from Sambro light, in a depth of 24 fathoms, and another 9 miles to the north-eastward of this in 37 fathoms. To stand in to leeward of these buoys in thick weather during a southerly gale would be a hazardous proceeding, as there are many outlying dangers in the vicinity."

As the conditions of weather are such that "south in the wind means fog, rain, or snow," it is evident that no prudent commander would venture to navigate his vessel between a whistling buoy and the land, in order to see if he could hear the sound of the whistle, so that under these worst of circumstances, with thick weather, and for a vessel approaching the land, a lee shore, the whistling buoy ceases to be of use.

The author is, therefore, of opinion that the mariner could be provided with a system of audible electric signals placed

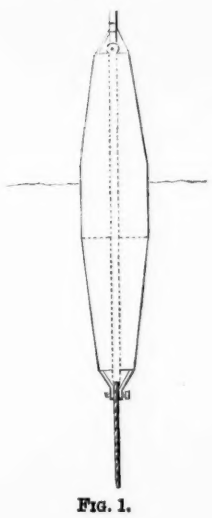


Fig. 1.

broad off in the offing at such a distance that vessels could boldly stand in to leeward of them, and thus be sure to come within range of their sound.

In coming to the details of his scheme, the author divides these under the following heads, viz., buoys, moorings, fittings, cables, and signalling appliances.

We are not quite sure that Mr. Hamilton has hit upon the best form of buoy for his purpose in either of the two forms he advocates. The spar buoy, as shown in fig. 1, is long and narrow and would ride well, but it would require a heavy mooring to keep it vertical.

To ensure successful working of electrical apparatus, at least comparative steadiness should be maintained, so that the buoy selected for the purpose ought to be of the most stable design. That pattern known as the "spar buoy," shown in fig. 1, although admirably adapted to the purpose of automatically sounding a whistle, would not, we think, prove suitable for the needs of an electric signalling system.

The buoy shown in the second sketch, fig. 2, would have

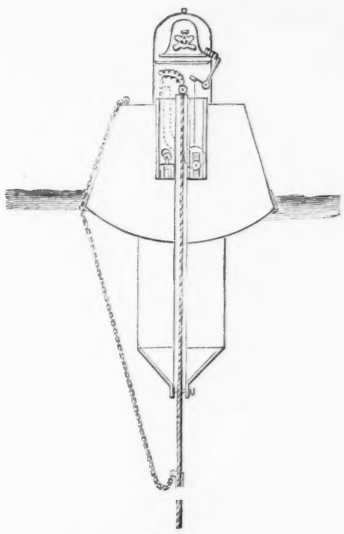


Fig. 2.

greater stability, but does not recommend itself as being of desirable shape, either from a constructive point of view, nor in its adaptability to the purpose. To lead the cable up the side of this buoy would be to curtail the existence of the cable considerably.

It is not made at all clear in the paper how the proposed protection could be afforded the cable by battens, &c., at the sharp angle of the junction between the truncated cone and the segment of the sphere forming the base of the buoy, the chain of a bridle, or a cable, sawing to and fro on an edge like this with the buoy in constant, though even slight motion, would wear either through in a few weeks.

As to moorings, well! we should say it is an axiom among cable men never to use a telegraph cable as a mooring for a buoy. With all the care the author has taken to prevent any undue strain coming upon the cable end within the buoy in suspending it from the buoy, he has apparently lost sight of the fact that the twisting motion of the buoy on its axis—the cable—would probably wring its, the cable's, neck in course of not too long a time. It might be that the adoption of a double armature to the cable of reverse lay might extend the chances of its survival, but it would undoubtedly go sooner or later.

Another fruitful source of injury to a cable in shallow water would be to put a rounding of chain upon it, for except this chain be laid around the cable perfectly tight, the motion on the bottom, due to currents and swell, &c., would make itself felt by causing the chain to continuously rub, one part against another, and also on the cable, all wearing away together. In the report of the United States Lighthouse Board for 1895, it is stated that, during the carrying out of an experiment in communication between lightships and the shore, in one instance the seaweed moving on the bottom in the rapid tidal currents of Vineyard Sound repeatedly broke the cable employed, necessitating frequent under-running and relaying.

Apart from this liability to injury to the cable through its having a loose fitting chain armour to carry, there would appear to be the objection to the extra weight, and the work entailed upon those engaged in laying the cables and establishing the buoys in their respective positions. Surely it would be better to provide a more suitable protection against abrasion by means of a heavier type of external sheathing.

The couplings for connecting each section, shown in fig. 3, are well enough adapted. They appear to us to be modelled

upon the pattern of a junction box for T pieces on deep-sea cables that we have seen at the Silvertown Works.

As regards signalling appliances the author furnishes but little information in his paper beyond the statement that he has recognised the necessity for providing a system by which each buoy would signal its own number.

There are several ways that would suggest themselves to electricians to attain this end, but the question would arise whether they could stand the test of such unusual conditions. Doubtless the author has devised one of the most simple of methods; a diagrammatic illustration would have made this part of the subject more clear. The mechanism

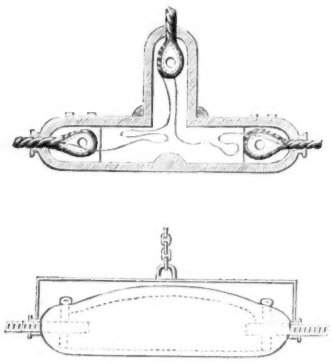


Fig. 3.

he employs consists of a small electric motor, which, besides performing the operation of working the lever connecting the rod leading up to the bell hammer, winds the spring of a system of clock work, by means of which the current is switched on and off at each buoy.

This is a sufficiently delicate combination of apparatus to keep in perfect adjustment boxed up inside a buoy, however carefully it may be secured and the connections made. The shock of seas breaking over the buoy in rough weather and the jerks consequent thereon, would be apt to derange the clockwork, and thereby interfere with the current being switched on and off at each buoy.

However well fitting and tight the box may be made which is to contain the electrical apparatus, there would be an aperture through which the rod connecting the lever with the bell hammer has to pass, so that any amount of moisture from the salt spray could penetrate to the interior, with the most damaging results to the connections and instruments.

The author says that this portion of the apparatus, together with the bell, can be readily shipped and unshipped, so that the appliances can be easily examined and overhauled, but electrical apparatus generally has, under ordinary circumstances, and at most inopportune times, a happy knack of developing elusive and vexatious hitches. In the case under notice, the tendency to aberrations of this nature would be magnified, owing to various causes, and it would not be too easy to go out in a boat to overhaul the signalling apparatus on all these buoys in a gale of wind and thick weather, just at a time when their warning tintinnabulation would be most urgently in request.

In thus drawing attention to the weak points in the system, we by no means condemn it. There are advantages in it over other systems, and it would be peculiarly suited to the conditions of weather, and the exigencies of navigation so graphically described by the author as obtaining off the harbours on the rough and dangerous coast of North America.

Like many other good ideas that have been formulated, and put to one side until a more favourable time shall present itself for development, this scheme has apparently lain dormant during the five years or more since the author first made his proposition to make use of electricity for the purpose of facilitating navigation under conditions which normally would be both difficult and dangerous.

In its inception the plan appears to be sound—this is no play upon words—and feasible.

Several buoys distributed across the approaches to a harbour at positions that would indicate to the commander of a vessel his whereabouts in thick and stormy weather would be a great aid to safe navigation, and a boon to all concerned.

With a remodelling of ideas as regards the details, especially in the matter of buoys and their moorings, we think that the system might be developed to a successful issue, and as there may possibly be others who have taken up this subject since the author first mooted the question, they will assist the scheme by publishing to the world what advances they have made. We agree with the author that much useful work may be done in the direction indicated.

MULTIPHASE CURRENTS IN MINING WORK.

One of the results of the opposition to overhead lines after experience had shown that the overhead system was practically imperative in the present state of electrical knowledge, and when, therefore, further opposition passed from the realm of proper caution to unreasonable immobility, has been to deprive manufacturing engineers of many opportunities for acquiring knowledge and experience of electrical power transmission and to hand work over to the foreigner. The marvel is how we have been able to compete at all, and the fact that we have done so only shows what the chances for our manufacturers will be when further experience has been acquired. We believe that as English machinery becomes better known it will be recognised that for its power rating the margin of size and safety is considerably greater than is the case with either American or Continental practice. American practice in other lines has always been towards the use of less material than English practice sanctions. In a recent example, not electrical, which came under our notice, a pressure reservoir which, by the ordinary rules of strength would require to be about a sixth of an inch thick, was quoted by an American firm of $\frac{3}{16}$th inch plate. Now, no maker in England uses plate less than a quarter of an inch thick, and generally there is a tendency to employ greater margins either in engines, pumps, machine tools or boilers, and in electrical equipment. Our extravagant use of material is not always commendable. It is frequently dubbed unscientific by foreigners, but it is by no means always the case that apparently excessive dimensions arise from lack of knowledge so much as from reasons of survival and evolution. American bridges serve to illustrate this. Years ago much was heard of the superiority of American pin-connected bridges. They were so easily calculable, and every piece took its own direct stress and could be closely calculated for it. But secondary stresses were soon proved to be developed which were due to pins not being frictionless points of rotation, and many details failed continuously, until finally they became as large as English practice had shown to be needful. In the midst of the cry for correct proportioning of parts to stress there had been one little oversight—the real amount of the stress.

Our electrical manufacturers, however, should endeavour to secure business in South Africa. The mines there seem peculiarly adapted to the use of electrical transmission, and much machinery has been sent out. Polyphase working is coming into favour, and attention was drawn by *Machinery*, a South African journal, to the paper read by Mr. Hawkins last year at the Northern Society of Engineers on this subject.

Engineers who are not electrical do not realise that in electrical generators in a multiphase system the winding of the rotating part is reduced to a minimum. This, obviously, must tend to reduce repairs, and this is specially the case with motors, which are usually placed where they are less cared for than even the generators. As an example of what has been done we may repeat a few particulars as to the plant sent out by the General Electric Company to the Vogelstruis Mine. It included two 150-kw. three-phase generators, belt-driven at 300 revolutions per minute, with a frequency of 30 and a pressure of 950 volts. The low frequency of 30 is probably due to the priority of American influence on the Rand. Motors at 360 revolutions per minute and of 35 H.P., drove three triplex single-acting pumps with 6½-inch plungers by 8-inch stroke through single reduction gear. They run at

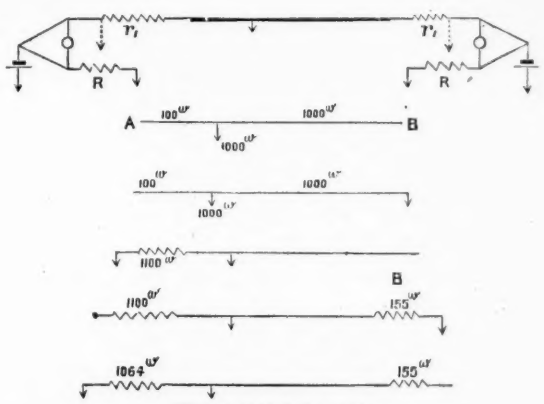
45 revolutions per minute under a head of 300 ft. 20-H.P. motors, also at 300 revolutions per minute, drive by simple reduction gears 12 similar pumps with plungers 4½ inches × 8 inches, also at 45 revolutions per minute under 300 ft. head. The main cable is triple concentric, each conductor having an area 0·118 square inch. It is 1,666 yards long. The branch cables are of same type, one of 430 yards with conductors of 0·047 inch each, and one of 1,300 yards with conductors each of 0·0314 square inch area. They are all lead covered and steel armoured. Somewhat similar plant was sent out to the Knights' Central Mine and to the Witwatersrand. In all, to these three mines were sent 45 motors from 5 to 35 H.P. In each case the generators were of inductor type, stated to give 91 per cent. efficiency at full load with a temperature rise after long runs of 45° F. Transmission lines may be simply bare wires on porcelain insulators.

The author from whom we quote expressed the desire that the three-phase system should be more taken up by English manufacturers, in view of the large amount of work of the kind which was to be carried out, and was falling to foreign firms.

TESTING TO FAULTS.

By A. JORDAN and W. SCHONAU.

In the Electrical Review of October 12th, 1894, we published a modification of the Earth Overlap Test, by which method it is possible to localise a fault without it being necessary for the two terminal stations to communicate with each other after each reading, the result being attained by the two stations taking alternately a certain number of readings balancing to a pre-arranged resistance "R," by varying R_1 and r_1.



Figs. 1, 2, 3, 4, 5 and 6.

As the readings in this case cannot be taken by the Mance method, R being constant, we propose to point out how it is possible, by a slight alteration in the proceedings, to use the Mance method, which in many cases, where the fault is liable to polarise, may be desirable.

Say A and B have to localise a fault having a resistance of 1,000 ohms in a cable having a C.R. of 1,100 ohms, the fault being 100 ohms from A.

As in our former method a test is first taken from the two ends, the distant end being to earth and the two results added = 600 + 1,091 = 1,691 ohms, say, 1,700 ohms.

A and B then agree to take alternately a certain number of readings (say, five each) by the Mance method, *increasing or diminishing* R_1 *and* r_1 *according to the obtained results fall short of, or are greater than,* 1,700 *ohms.* For instance:

1.—A, testing with the distant end to earth, gets 600^{ω}, he therefore inserts $1{,}100^{\omega}$ and earths for B through this resistance. B now testing gets $1{,}545^{\omega}$, this being 155^{ω} short of 1,700 he inserts 155^{ω} and earths for A.

2.—A now testing through his own $1{,}100^{\omega}$ and B's 155^{ω}, gets $1{,}736^{\omega}$, and consequently reduces 1,100 by 36 to $1{,}064^{\omega}$ and earths for B. B now gets $1{,}693^{\omega}$, increases 155^{ω} to 162 and earths, and so on until each has taken five readings, the subsequent results being—

3.—A 1,702 (reduces 1,064 to 1,062). B 1,700 (leaves 162 unaltered).

4.—A 1,700 (leaves 1,062 unaltered). B 1,700.

5.—A 1,700. B 1,700.

They now communicate with each other, and as the last two readings are equal, we have—

$$\text{Distance to fault from A} = \frac{1{,}100 + 162 - 1{,}062}{2} =$$

100 ohms.

ENERGY CONSUMPTION ON ELECTRICAL TRAMWAYS.

A recent issue of the *Elektrotechnische Zeitschrift* details some trials made by Mr. Schiemann, of Messrs. Siemens and Halske, upon several four-axle tramcars on the Berlin-Charlottenburg line which had been about half a year at work. The endeavour was to find the demand upon the accumulator batteries and the sudden draughts they had to bear at starting times or speed changes. Inquiry was to be made into the marked diminution of their capacity, and whether this was due to general overwork, demanding too much energy, or to sudden excessive demands, and into the means of remedy. Six differently equipped cars were employed in respect of motor excitation, series or shunt, the coupling of the windings, and the excitation. In all there were two principal speeds due to the series parallel coupling of the two half batteries. Intermediate speeds were produced by rheostat control of the excitation. Starting resistances were introduced in the armature circuit.

The sudden change from 180 to 360 volts, due to the change of battery coupling, was dealt with by a rheostat divided into two or three divisions, suppressed in turn. In order to make the trials practical, each vehicle tested was made to follow one in service at a little distance, making corresponding stops. The consumption of energy was thus brought to a practical basis. The weather was variable, the road surface variously beton, asphalte, paved, or macadam, and the cleanliness of the rails also very variable. The mean of the six vehicles showed an energy consumption of 27·75 watt-hours per ton kilometre, including all stops. Five of the cars had Siemens & Halske equipment, the sixth that of Kummer & Co., of Dresden All had bogies.

In the five vehicles the weight was as follows:—

	Kilos.
Car	9,800
Battery	6,840
Electric equipment	3,200
	19,840

In the odd vehicle the weights were

	Kilos.
Car	9,800
Battery	5,000
Equipment	2,300
	17,100

In each about four to seven persons were carrie and in the full charge trials ab.ut 2,800 to 3,000 kilos of lead. The motor of the one car was of less power than t others. The course run was 7,800 m., with 26 signal stops verage 300 m. apart. The battery of a car should have 330 perc-hours at a rate of discharge of 30 amperes, and 305 pere-hours at a rate of 45. The motor fields are excite by a half battery only, and the two motors have their fields in series. The field rheostat had five resistances, the starter three. This and another car worked at 185 volts, the remainder at 370 volts.

With the various methods employed of connecting up the differences were not great. The mean weight of a car was 21,600 kilos, the mean number of stops per km. was

1·87, the consumption 27·75 as stated above, and the speed, when coupled in parallel, 14·3, and in series 23·6 km. per hour. The mean coefficient of traction corresponding to 27·75 kilowatt-hours is 0·01008. The coefficient of efficiency between the battery terminals and the rails cannot be above 75 per cent. This reduces the traction coefficient to 0·0075. The energy lost at stoppages, however, is 11 watt-hours per ton, which is included in the total figure of 27·75, and shows the cost of stoppages, and, we may add, may be calculated as a constant expense for a road having turnouts and a single line.

The author's conclusions were that the batteries did not, at the end of a journey, contain sufficient charge to support the sudden calls made on them; hence prejudicial structural changes of the electrodes and less durability. The reserve of energy necessary should be equal to that expended. In changing over the coupling of the battery the attendant may do harm if not very careful. To prevent evil effects a large energy store is necessary.

About every 20 days each vehicle may be counted upon as liable to be out of work by reason of battery troubles. Each vehicle absorbs, say, 1,000 watt-hours at the terminals of the charging dynamos. At 0·10 franc, or, say, 1d. per kilowatt-hour, a vehicle costs 15 francs per day for energy. If, with a simpler mechanism, the cost of charging is 10 per cent. more, or 16·5 francs per day, a single day's stoppage, rendered necessary by the more costly, but economical, machinery, would, without counting the repairs, cost 12·5 francs in interest, &c., charges, and $\frac{12\,5}{1·5} = 8·33$ days of excess cost of energy thrown away in one day's stoppage. The charge of 12·5 francs is obtained from a first cost of 43,750 francs, and 5 per cent. for interest and sinking fund. Thus the shunt motor calls for more resistances and more wires, junctions, and contacts than a series wound motor, and does not appear to have an advantage in battery work in a flat country, but they should be useful where recuperation on gradients can be used in place of brakes. This is of no use, however, at ordinary stoppages. Shunt motors, it is concluded, should be better justified when taking current direct off trolley or conduit lines in an undulating country, when the current produced by the cars enables them to run quietly down hill and assist to feed the lines.

ELECTRICAL UTILISATION OF WATER POWERS.

IN discussing the question of water-power, Mr. L. Magie, in *Cassier's Magazine*, starts from the cost of steam power as a datum line whence to estimate the possibility of selling electric power at a profit.

If to instal electrical power does not cost more than £20 to £28 per horse-power the investment will probably be profitable if well managed. For direct current work, though 12 miles have been covered by a transmission, only two are desirable, and this is by no means to be undertaken lightly. Alternate currents alone can be practically transmitted. In long distance transmission the weight of copper in a line is directly proportionate to the power to be transmitted and to the square of the distance for equal efficiency. Thus if 100 H.P. be transmitted 1 mile or 10 at 500 volts, with an equal loss of 8 per cent. in either case, there will be required in the one case, four 0000 wires, weighing 15,312 lbs. and costing nearly £500; in the other case 40 of the same wires would be needed weighing 1,500,000 lbs. and costing nearly £50,000. At 10 per cent. the power would cost $2.30 and $230 per annum per H.P. in the two cases.

Raise the voltage to 5,000 and only two wires would be needed, or the same in weight and cost as the one mile transmission at 500 volts. Our author speaks strongly in favour of high rotative speeds, and obviously, high speeds of generators are best obtained from high falls of water. Indeed, low falls of water demand such heavy works in the shape of wheels and storage, that it is doubtful if some of them are worth saving. He would prefer to belt drive a generator rather than use a large one at so slow a speed as 75 or 100 revolutions per minute. High voltage, of course, is tempting, but it is better to keep voltage as low as possible consistent with commercial conditions. High voltage means more costly insulators, and more expensive apparatus and greater risks.

With copper so high in price as it now is, there must be great inducement to reduce it where this can be done, and to reduce line costs to a minimum, the idea will need to be developed and carried out of a separate financial arrangement for lines, so that money can be borrowed on these at a low interest, the copper being practically indestructible. Smaller wire than No. 6 B. & S. is not desirable. Even No. 4 is by some held to be the smaller limit. It is, therefore, folly to attempt any voltage which could be run on a smaller wire than No. 6. Hence the question of voltage is more or less self-adjusting.

WIRING RULES.

THE Royal Insurance Company have just issued a set of "Rules for Electrical Installations," which come before the public at an opportune time for discussion. Another set of rules imposed upon contractors makes confusion worse confounded, and it is not altogether an unnecessary task to examine these and find if there is any obvious reason for their existence. We certainly incline to the opinion that the personal element—that anxiety to have a baby of one's own—is at bottom the cause of the multiplicity of rules.

The Royal rules open with the statement that electrical fires are principally caused, or likely to be caused, by:—

1. Inferior materials and workmanship, particularly in joints, fittings and connections.
2. Conductors of inadequate size and conductivity.
3. Perishable and inferior insulating material.
4. Moisture, dust and dirt.
5. Neglect of periodical testing and inspection.

As regards conductors, it is interesting to compare the Inst. E. E. figures with those in the table of the rules before us:—

S.W.G.	For incandescent lamps only.	For other purposes.	Inst. E. E.
18	2·7 amperes	1·8 amperes	4·2 amperes
16	4·8 "	3·2 "	6·8 "
14	7·5 "	5·0 "	9·8 "
7/22	6·6 "	4·4 "	8·7 "
7/20	10·0 "	7·2 "	13·0 "
7/18	12·8 "	12·8 "	21·0 "
7/16	22·9 "	22·9 "	34·0 "
7/14	35·6 "	35·6 "	49·0 "

These figures show maxima of about 60 per cent. to 70 per cent. of the current permissible under the Inst. E. E. rules, and the ratio does not vary much with the size of conductor. This is rather curious, but it is still more astonishing that the maxima given "for other purposes" should be identical with those "for incandescent lamps" on the larger sizes, when one remembers that heating is usually found on main or circuit cables, and not on sub-circuits or branches. Again, if additions are put on, the wireman generally has to run branches for these extensions, but is prone to utilise the existing mains or circuit cables. For 7/18 S.W.G. and upwards to 19/16, the Royal figures are based on the old rule of 1,000 amperes per square inch section; above 19/16 the special purposes limit is reduced below that for incandescent lighting, thus:—

19/14 S.W.G. 97·3 77·8 110·0

The reason for this erratic variation is by no means obvious, and is not explained in the rules. We certainly think on this point framers of rules might take the Inst. E. E. figures, less a fixed percentage, for safety, and to allow of inevitable and frequently unnotified extensions, instead of drawing up irrational tables. The wireman uses a table to find the size of wire he must obtain, and 9 out of 10 jobs are wired on the 1,000-ampere per square inch table,

which is well within the Inst. E. E. figures, and has the advantage of being got at quickly from a table of areas.

Next as to insulation; the insulation resistance of the dielectric is prescribed as a minimum of 300 megohms per mile. This is a survival of the old rule, which took little heed of the size of conductor, and demanded a ridiculously low value for small wires, compared with larger. Compare, for example, the 1,200 megohms for 18, 17, and 16 S.W.G. of the Inst. E. E. rules with the 300 megohms here given.

We now come to the weak points of ordinary work, the connections to switches and fuses, and the details of joints. Back connections and hidden ends sweated into coned sockets or lugs are prolific sources of trouble, unless the manufacturer has devoted extreme care to grinding-in and fitting the male and female parts together, and the wireman has the spirit of the skilled mechanic in him, and fits the parts into one another instead of placing them in juxtaposition, slipping on the nuts, and leaving the job as finished. Yet illustrations of coned sockets and back connections are given on p. 17, while on p. 18 occurs this clause:—

"Cut-outs and switches to have the points of attachment for the conductors on the front. No uninsulated conducting part to be at the back."

Another weak point in shop wiring is the extensive use of flexible cord for window wiring. This is prohibited by the Institution rules, and also by the Royal rules, in the following words:—"Flexible cord conductors never to be used except where they are necessary for pendant or portable fittings." Let those who frame such rules try to wire a modern all-glass air-tight window, such as is largely used by tobacconist stores' companies, drug stores' companies and such like firms, and they will find that, rules or no rules, the wiring contractors are compelled by the architect and proprietors to wire the window with flexible cord. What is wanted, therefore, is a recognition of this difficulty, and a definitely prescribed method for meeting the case. We know of numerous cases where, in lieu of an abortive prohibition, it is dealt with by insisting upon the flexible being run at short intervals through porcelain ring insulators, and protected at corners by a few inches of rubber tube slipped over the wire. The "effect" is saved, while the necessary safety and security from leaks and faults, are gained by the adherence to the spirit of all fire office and supply rules.

We are glad to see that the Royal rules give prominence to the looping-in method of wiring several ceiling roses on one sub-circuit. This enables joints to be dispensed with, and is a most satisfactory way of dealing with ordinary shop and window work; but if ordinary stranded or even single wire be employed, instead of flexible, care must be taken to obtain roses with larger holes in the base than are customary.

There are one or two requirements that savour of the collegiate student rather than the practical man. Such, for example, are the following:—

"Cut-outs, switches, and rheostats to be plainly marked with the volts and amperes for which they are designed."

"Electric heaters and cookers to be plainly marked with the normal capacity in volts and amperes."

"Binding or tie wires to be coated with insulating material."

We are afraid manufacturers have yet to turn out accessories with such particulars "plainly marked" upon them.

In contra-distinction to the Manchester rules, which, as we pointed out in an article some time ago, insist upon kettles and radiators (as well as motors) being earthed, the Royal rules appear to prefer the frames insulated by "non-conducting bases." The insulation specified is 20 megohms per ampere, tested with not less than 200 v., giving, say, the 112 megohms, cited by Prof. Ayrton at the last meeting of the Institution, for a 200 v. 8-C.P. lamp. Altogether, perusal of the Royal Insurance Company's rules convinces us that the latest addition to the batch is not much more than a variation upon its predecessors, with but little gained, and it is a pity the Institution rules could not have been adopted in their entirety, with one or two detail modifications in wording, and a stiffening, perhaps, of the required insulation resistance. The rules before us are well arranged and printed, but the text and the illustrations unfortunately clash in more than one instance. The latter portions devoted to special rules for theatres, mills, drying stoves, produce warehouses and central stations, are less open to criticism, partly owing to the peculiarly specialised class of work to be met, and partly because the Institution rules do not attempt to cover this ground. Due attention is drawn to the necessity for auxiliary lighting in central stations, but it is not so clear that any good would result from a multiplicity of printed instructions being hung about the works as a guide to the attendants "as to the use of the devices they have to operate upon the swithboards." Capable and suitable men know their work, and do not require such "aids;" others are neither likely to be assisted by them, nor to stand the strain of shift duty in a modern station for many weeks. We have also yet to learn of many stations whose buildings are "entirely fireproof with no combustible material entering into any part of the construction *or roof* except the external windows and doors." (The italics are our own.)

In conclusion, we cannot but regret that a more earnest attempt is not being made to adopt the excellent rules of the Institution of Electrical Engineers, as it is only by trying them in extended and every-day practice that sufficient experience can be gained to say exactly where and how they must be modified, stiffened or added to, to meet the general call for a draft wiring specification to which contractors may be required to comply by supply companies, fire offices, consulting engineers, and the man who foots the bill—the consumer.

AN ELECTROLYTIC CURRENT INTERRUPTOR.

A remarkable discovery has been made by Dr. A. Wehnelt, of Charlottenburg, which will be of the greatest importance in the construction of induction coils and other apparatus where high frequency intermittent currents are required.

The weakest point of the present day induction coil is the break. If the coil is to be utilised to its full extent, this break must be very rapid, making, say, about 1,000 per second. But even a very rapid electromotor break gives only about 25 per second. Another defect of the present breaks is that they do not instantaneously stop the current, owing to the leakage across the air or liquid gaps interposed in the circuit. The condenser has to be made use of to obviate this evil to a certain extent. But if a sufficiently good insulator, to prevent leakage at the gap, could be obtained, the condenser could be dispensed with. All these ideals appear to be realised by Dr. Wehnelt's electrolytic break; the output of a coil may be increased forty or fifty-fold, and a condenser is no longer necessary. The construction of the break is simplicity itself compared with the complicated mechanical arrangements at present in use. The following is the essential part of the explanation of his invention, given by Dr. Wehnelt in the *Elektrotechnische Zeitschrift*, January 26th, 1899.

If a current is sent by means of two electrodes of unequal surface through an electrolyte, the E.M.F. applied being considerably greater than the counter E.M.F., of polarisation then well-known light and heat phenomena may be observed on the electrode with the smaller surface. This electrode with the smaller surface has been called the "active" electrode. These phenomena have been investigated in a very thorough manner by Planté, and by many others, and Lagrange and Hoho have founded upon them their welding and hardening process.*

Everybody who has worked at this subject has observed that the current is not continuous, but of a rapidly intermittent nature. This is indicated by a loud humming sound proceeding from the cell; and the intermittent character of the current has also been established by means of the telephone by Koch and Wüllner.†

Wehnelt proceeded to investigate the exact nature of this intermittent current in order to ascertain whether a complete interruption of the current took place, or whether it was merely a reduction of its intensity. If the first assumption was right, then, by inserting the electrolytic cell in the primary circuit of an induction coil, the discharge should take place as with any of the ordinary breaks.

* Lagrange and Hoho, *Lum. Elec.*, 1894, Vol. 52, p. 113.
† *Wied. Ann.*, 45, pp. 473 and 759, 1892.

In the following experiments a glass beaker, *a*, fig. 1, with dilute sulphuric acid, was made use of. The electrodes consisted of a lead plate, *b*, and a thin platinum wire, *c*, dipped in the liquid. To prevent spurting of the acid, the platinum wire is fused into the end of a glass tube, *d*, from

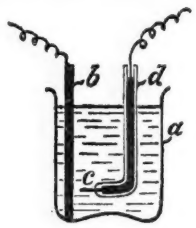


Fig. 1.

which it projects only a few millimetres. By means of this tube the platinum can be dipped so deep in the acid that no spurting takes place. The tube is filled up with mercury, into which one terminal of the battery is dipped. The battery used consisted of 60 portable accumulators. Three induction coils were experimented with, one of 3 cm., one of 30 cm., and one of 50 cm. spark length. The coils were worked from the Berlin lighting mains.

The first experiments were made with the small 3 cm. coil. The above described apparatus, fig. 1, was put in the place of the ordinary break. In fig. 2 I indicates the induction coil, G the condenser, U the break, and S the source of current. On gradually increasing the current till the light phenomena appeared at the "active" electrode, a weak irregular discharge of sparks took place between the point and plate on the terminals of the secondary coil. The "active" electrode, which hitherto, as in Lagrange and Hoho welding process, had been the cathode, fused very quickly. It was then decided to try the experiment with the "active" electrode as anode. The result was marvellous. Even with a compara-

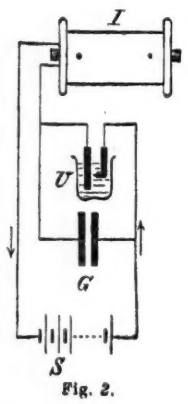


Fig. 2.

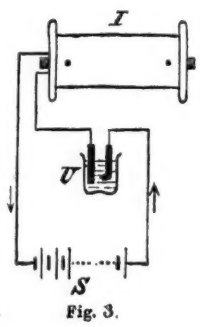


Fig. 3.

tively small voltage, at the instant that the light appeared on the platinum point, a stream of sparks passed between the terminals of the secondary. When the voltage was 80 to 90 volts, and the current about 3 amperes, the secondary discharge was transformed into a direct current arc, which emitted a loud whistling sound, and could be extended to a length of 7 cm. This experiment showed that the interruption of the current must be very complete, since otherwise a secondary discharge of so great a length could not have been obtained.

This experiment encouraged Dr. Wehnelt to try his electrolytic break with the 30 cm. and 50 cm. coils. The success was as great as with the small coil, only the effects were correspondingly more powerful. Even with six accumulators the coil began to work. With a current of 6 amperes, the frequency of the break was already as great as that given by the Despretz break.

By increasing the voltage applied, arcs of 28 cm. and 46 cm. were obtained, giving a note corresponding to 1,000 breaks per second. With no break hitherto made, excepting perhaps the turbine break of the Allgemeine Elektricitäts Gesellschaft have such results been obtained.

The breaking of the circuit effected by the electrolytic break is so complete that a condenser becomes superfluous. The simplest arrangement, without a condenser, is shown in fig. 3. The frequency of the breaks increases as the applied voltage increases. This is a most valuable property of the break, since without it, it would be impossible to apply high voltages to the coil without destroying it. Dilute sulphuric acid of 20°—25° B has hitherto been found best for use in the electrolytic cells. Any metal may be used for the cathode. For the anode (the active electrode) platinum has been found to be best. The frequency of the breaks has been measured by the musical note emitted, and has been found in some cases to be as high as 1,700 per second.

The strength of the current increases with the surface of the active electrode. This is a valuable property, since instead of using energy-consuming resistances to regulate the current, it is only necessary to adjust the surface of the active electrode to give the required current. From a series of measurements it was found that the current per mm^2. was 0·41 ampere. With the increase of the current the frequency of the breaks becomes less.

This break has been found well adapted for the production of Röntgen rays. Flickering on the phosphorescent screen completely disappears. The time of exposure for Röntgen photographs is greatly reduced, as would be, of course, expected from the continuous nature of the discharge. Owing to the complete utilisation of the coil, results can be obtained with much smaller apparatus than hitherto. A 2 cm. coil, for instance, is sufficient to light up the hands, feet, and other thin extremities of the body. A 15 cm. coil, connected up to a 30 cm. tube, suffices to illuminate the thickest parts of the body.

The break is likely to prove specially useful for the Tesla oscillator and for Marconi telegraphy.

Fig. 4.

Fig. 4 shows the break as supplied by the firm Ernecke, Berlin.

THE ELECTRIFICATION OF STEAM RAILROADS.

That steam can be superseded by electricity on all but trunk railroads nobody doubts. Nor have we ever heard a doubt expressed as to the possibility of soldering the proverbial broken sixpence. When Prof. S. H. Short talks of the general re-adjustment of business and social conditions, whatever this may mean, to a standard of 125 miles per hour, we fear that most engineers will be inclined to set his talk down as another sample of laboratory ideas insufficiently supported by practical knowledge and experience. If there be one thing above another which converts a moderate prime cost into a very heavy ultimate expenditure, it is the continuous product of efficiencies. We would not belittle the potentiality of electrical transmission. With thousands of miles of tramway and suburban railways to be yet commenced and worked electrically, and with numerous short branch railways on which electricity could be economically applied, the problem

of trunk line working might be allowed to rest awhile, and left to be accomplished as time shows how far it is practicable. The steam locomotive may not be a high-class condensing engine, but it is a remarkably efficient combination of boiler and high pressure engine; it is exceedingly elastic in its powers, and easily controlled. In comparing the cost of electrical working with the cost of steam locomotives, the commercial rendering of the latter can be usually obtained from actual records of performance. Against these records there is figured out the cost of electricity. Boilers are assumed always clean, and at maximum output and efficiency. Engines are all high-class, and give a horse-power for about 1¼ lbs. of fuel. Generators have maximum efficiency, and so have motors, and the line efficiency is such as might be obtained across a portion of the Sahara or the Australian desert.

Let us suppose that generators, up-transformers, down-transformers, line and motors, have each 90 per cent. efficiency. Then the net efficiency between engine and rail is $\cdot 9^5$, or 59 per cent. At 80 per cent. all through, a more probable efficiency, the result is barely 33 per cent. At present, a good line efficiency implies frequent power houses along a railway with all the expense of buildings and attendance, and if, as Prof. Short suggests, gas power is to be employed, there would be a costly gas pipe to set against line efficiency. Electricity is essentially an agent of transmission. When professors of engineering lend themselves to excessive claims for its powers, almost on a par with the belief of the vulgar, that electricity is a prime mover because they do not see the power house behind the screen, they do harm.

A Great Northern locomotive is said to consume about 23 lbs. of coal per mile, or, say, 1,200 lbs. per hour. This is a figure which does not represent a heavy coal consumption per H.P.-hour, and one not easily beaten even by the best gas engines, when these are combined with transmission and transformation losses. On the question of repairs, also, there is a tendency, we feel sure, to very seriously under-rate the expenses of electrical plant. So far, all is new. On a steam railway there has long ago arrived the time when half the plant is half worn out. Some of the locomotives were new this morning; others go to scrap heaps to-morrow morning. It will be some years before the same ratio of depreciation exists for any electrical line, and we are confident that it is yet early to attempt any calculations for main line economy. On the other hand, there is an ample field for electrical extension, especially in England. So far we have practically no electrical tramways, and what we have are, some of them, spoiled by single line and turnouts.

There is the London Underground, which requires something other than fired locomotives, no matter what the relative economy. There are branch railways, with their two or three journeys per day, of a shuttle train, which ought to be run as a day load from the lighting plant at the small town terminus of the branch. But Prof. Short is writing from an American point of view. In this aspect there is more to be said for electrical traction than here.

Lighting has gone ahead in America so rapidly, because gas there costs from about 5s. to 10s. per 1,000 cubic feet. Similarly, from some cause, the fuel economy of the American locomotive is peculiarly low, and electrical traction in this respect would stand very much on all fours with electric lighting. It would have a less potent rival than it has in England.

The year 1915 is the year fixed by Prof. Short for the supercession of the steam locomotive by the 125 miles per hour electric motor. Yet there is nothing very likely to be much improved in efficiency, unless it be the line work. The only obvious economy would be in the fuel, though there might be economies in repairs to a moderate amount. Fuel economy could only come in the use of, say, the waste gases of the blast furnace, but as the system of their utilisation becomes more extended, these now wasted gases will obtain a price, and find a ready sale in so many directions, that the surplus will not be large. There are 20,000 locomotives in the British Isles. If we assume half of them to be at work for 15 hours a day at 200 H.P., we get a mean power of 1½ million horses for 20 hours daily. The North-Western Railway alone, on this basis, would require some 800 full-sized steam boilers on its system on the assumption of even division of power to each boiler, and without spare boilers.

We think the future of main line traction may well be left over to its natural development, and that present energies and thoughts should rather be directed to overcome the unnatural retardation of County Councils and the narrow local views of small municipalities which stand as so many unnecessary full stops in lines of possible communication by electrically operated tramways.

STEAM TURBINES.

By RANKIN KENNEDY.

The steam turbine is not such a novelty as one would imagine, considering that only of recent years it has come into practical operation.

A reference to patent specifications back as far as 50 years reveals the fact that many engineers have essayed to construct satisfactory steam turbines, but before the day of dynamos few machines were in use requiring or capable of being driven at steam turbine velocities, hence even although some early turbines were fairly well designed and constructed there was not much use for them.

We have now come to regard the dynamo and steam engine combined simply as a machine for converting heat into electricity, and wasteful as the process is known to be, yet the steam dynamo produces electrical energy cheaper than any other known generator.

The reciprocating piston engine has hitherto held the leading position and will be difficult to beat, yet the fact that dynamos can be built easily to run at speeds 10 times greater than any reciprocating engine points to the combination of turbines and dynamos as a natural one.

We shall consider the turbine from its historical point of view first, so that we may know just how far we have got in their development, and what we owe to pioneers in the work.

The first steam engine of which we have any record was by Hero, of Alexandria, a little over 2,000 years ago, which was a steam turbine.

Coming down to modern times, we find a considerable number of inventors engaged on the steam turbine dating from about 1840. E. Locke and J. J. Cordes in that year patented a steam turbine, No. 8,572; this turbine had a single wheel with blades, against which the steam was thrown as a jet.

A very important patent follows this in 1842, No. 9,354 by James Pilbrow, who must have made a complete study of the subject; the specification is, in fact, a small treatise on the subject, but it is now out of print. It describes a turbine wheel revolving at 34,830 feet a minute, driven by three jets of steam having a combined area of 2·37 square inches, and giving 153 horse-power with 60 lbs. pressure. The figures given regarding water evaporated by his boiler would prove that this turbine gave 1 horse-power-hour on a steam consumption of 25 lbs.; not a bad performance in 1842.

Pilbrow discovered the important fact that a steam jet does not expand laterally, but expands in its line of issue, hence he formed the nozzles of his turbines with this in view, allowing the steam to expand forward in its line of issue and so acquire the full velocity due to the pressure, this specification anticipates many of the most recent patents.

The same inventor took out another patent in 1843, No. 9,658, still further improving the steam turbine, and describes a number of experiments to ascertain the best speed and power of his wheels; he fixes 76,000 feet a minute as the best speed for his wheel blades, a speed which has been confirmed by recent practice, he calculates 20 lbs. of steam per horse-power per hour as the possible consumption at 60 lbs. pressure.

Passing over several unimportant patents, we come to one by Robert Wilson, No. 12,060 (1848). Here we find the idea of working many turbines in series order, that is, to use the steam first in one turbine then in the next and so on through many.

This inventor describes the two types of turbines, the pressure turbine and the free jet turbine, he describes the expansion of the steam, and how each successive wheel must have larger jets to allow for expansion.

Pilbrow and Wilson contain the elements of all successful steam turbines. Passing over many others we come to Richard Boyman's patent, No. 1,155 of 1860. This specification is a treatise on the inventor's ideas, and covers 57 pages of letterpress; he argues that the proper way to apply steam to turbines is to make the steam jet or blast intermittent, *i.e.*, entering in a series of puffs, a principle now applied to one modern turbine for governing its speed.

In 1862 Patent No. 1,568 describes a series of turbines, the series being adopted in order to reduce the speed of the wheels.

A study of the patents show that nearly every kind of turbine wheel and jet has at one time or another been applied, and that the science of the steam turbine was pretty well understood at an early date.

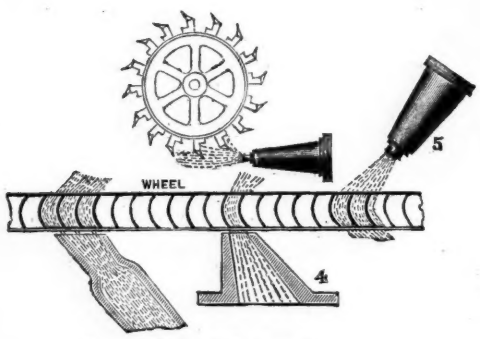
The difficulties in the way of these early inventors were greatly due to the high speed necessary for efficient working, and although it was early known that by placing a number of turbines in series the speed could be reduced, yet there came up a great difficulty in constructing turbines in series with their many steam joints and passages; even now with all the modern tools and machinery at command the construction of a series of turbines on one axle with steam tight joints is no easy job.

We may now leave the history of the turbine and consider its construction.

There are only two distinct types of fluid pressure turbines. First, the free jet turbine in which the fluid issues from a jet or jets at the full velocity due to the pressure then, impinges on the wheel blades, is turned back and out of the wheel with little or no velocity remaining. Second, the pressure turbine, in which the fluid acts by difference of pressure and moves, not with a velocity due to the full pressure, but with a velocity due to the difference of pressure between the parts in action.

To make the distinction clear, we may take a case wherein we want to perforate a sheet of metal with a ½-inch hole. We could quietly and easily punch the hole by sheer pressure slowly, or we could perforate it instantly by firing a steel rifle bullet through it. In the last case we send the bullet with a velocity due to the gaseous pressure in the rifle; it strikes the plate, and exerts a pressure little less than the pressure which discharged it.

The best example of a free jet turbine is the Pelton wheel shown in fig. 1. It is typical of the impulse turbine, and with certain modifications is a good steam turbine.



Figs. 1, 3, 4 and 5.

The fluid issues from the jet and acquires a velocity due to the pressure; it strikes the wheel blades as in fig. 2, is split up and turned backwards; but to turn it back the blades receive the full pressure due to the velocity.

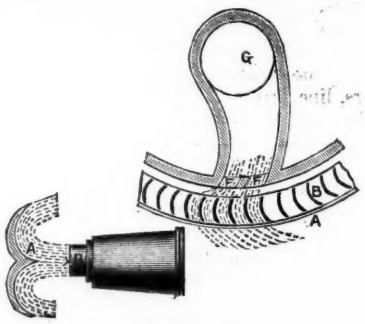
Now there is a certain distance between A and B, the blade and the orifice which gives the best results with any given pressure, the higher the pressure the longer the distance necessary. This distance is necessary to allow the jet to acquire the full velocity, and this takes a little time. The object in view is to convert the pressure into kinetic energy with little pressure remaining in the fluid. This is obtained in the Pelton wheel by adjusting the distance A to B.

In fig. 3 the fluid expands in a conical nozzle acquiring full velocity before entering the wheel, this is the device used in the De Laval turbine.

A plain conical nozzle, if applied as in fig. 4, close up as possible, does not allow of the full velocity being acquired before entering the wheel, it enters with nearly full pressure and leaves with full velocity nearly, thus carrying off much energy wasted.

By using a movable nozzle the distance of which can be altered from the wheel as in fig. 5, a position can be found for different pressures at which the steam enters at full velocity upon the wheel blades and leaves the wheel at a very low velocity having given up nearly all its kinetic energy.

Whether there is any advantage in the expanding nozzle of fig. 3 is an open question, but the principle is that discovered by Pilbrow shown in fig. 5; the steam acquires



Figs. 2 and 6.

velocity in a forward direction up to a certain distance, that is, it expands in the line of issue, so that the orifice must be far enough from the wheel to allow of expansion in the line of issue down to atmospheric or condenser pressure.

Fig. 6 shows an outward flow impulse turbine; here, again, the nozzles are with advantage some distance from the wheel to allow of the full velocity being acquired before the fluid enters.

Now, as to velocities, to obtain any speed approaching that which would give the highest efficiency for an impulse steam turbine is perhaps impossible. The highest speeds of the periphery within practical range is less than one-fourth of the velocity of steam. Issuing into atmospheric pressure at 75 lbs. per square inch pressure, the velocity is 2,625 feet per second, and into a common engineer's condenser 4,600 feet per second, whereas the practical limit for the speed of a turbine wheel is about 600 feet.

The simple impulse turbine must therefore be always an extremely high speeded engine, in fact, to get near the possible efficiency, the speed of the periphery of the wheel should not be less than about 80,000 feet per minute, in other words, an 8-inch wheel would run at 40,000 revolutions.

Notwithstanding the drawbacks of extremely high speeds, M. Gustav de Laval has succeeded in constructing practical working turbines on the free jet impulse system, many of which are at work, principally driving dynamos.

(To be continued.)

THE INSTITUTION OF ELECTRICAL ENGINEERS.

The discussion of Mr. Crompton's, Mr. Wordingham's, and Mr. Pigg's papers on "Wiring Rules," was resumed at the meeting of the Institution of Electrical Engineers on Thursday evening of last week.

Prof. Ayrton referred to the few words he had said at the last meeting upon the desirability of obtaining information why such variations were to be found in the specification of the insulation per lamp-fixed as given by different rules. An endeavour should be made to see whether any particular system was adopted in selecting such standards. He had compared the figures, given in the appendix to Mr. Pigg's paper, for systems with direct and with transformed supply, but the system in use did not seem to determine the insulation. For example, Nottingham, with direct low tension supply, insisted upon 75 megohms per lamp, while

Oxford, with continuous current transformers, was content with 12·5 megohms. In this example the low tension system required six times the insulation of the other. Westminster again—a low tension supply—was the highest of all going up to 112 megohms. Inconvenience arose from the divergent requirements; in London, which for supply purposes consisted of a number of districts joined together, houses on opposite sides of a street wired by the same contractor were passed in one case and rejected in the other. One very curious result of the inconsistencies was that a wiring job rejected by one supply company would be changed over to another and competing company and gladly accepted. The fire offices appeared to take an insulation resistance lower than any supply company would demand, and they seemed to rely upon the rejection of work by the supply company as a safeguard; if the thing was at all safe on their figures there was no real need to go higher, but Prof. Ayrton repeatedly stated that he was an advocate for high insulation, not for reducing the standard, although he desired to ascertain how the standards in vogue were arrived at.

The next question was the specification of the wire. The Institution rules specified wire of from 1,200 down to 300 megohms per mile, but the Blackpool rules and others demanded no less than 2,500 megohms per mile. Prof. Ayrton would like to know whether consulting engineers were in the habit of testing any of the wire supplied under such specifications. He endeavoured to see he got what he asked for. Take flexible cord for example; he had made tests of certain material of this class supplied which was put in to a specified figure of 300 megohms per mile. Having laboratory facilities at his disposal, he was able to find that one sample gave only $\frac{1}{200}$th of the figure asked for. Another showed as little as $\frac{1}{1000}$th. The test was given as 300 megohms per mile after 24 hours' immersion in water with a testing pressure of 400 volts, and one minute electrification at a temperature of 60° F. Other samples gave such low results as 23,700 ohms and 1,000 ohms. Thinking that the last result was wrong, he had the piece cut into six or seven separate lengths, and each of these were tested, but all were bad, showing that the low insulation was not due to any mechanical accident but to poor material. That wire to-day gave only 200 ohms per mile!

The proof that he was not asking for an impossibility or for wire which makers could not turn out was shown by other samples. One of these stood 9,800 volts before breaking down, and had an insulation resistance of no less than 2,300 megohms per mile. The insulation resistance of wire seemed usually as nominal a figure as the insulation resistance per lamp.

Mr. Raworth followed with a promise not to mention the word "megohms" more than once. He wanted the meeting to consider that, of the papers, two were mild and pleasant ones. He then dealt with the third. He had been to Manchester, and it was the worst of all schools of municipilisation. The attempt to enforce such rules as those now before the members, was coupled with an attempt to persuade the ratepayers of Manchester that it was all for their benefit. If this was generally adopted, it would make this little island of ours more of a purgatory than it was at present.

He held pretty strong views on the question, but he pointed out that he was the first to introduce fuse cut-outs, and the first to get switches and fuses made with porcelain bases. Electrical fittings were now made as well as gas fittings. Everything possible was done to make electrical fires impossible. How, then, is it that electrical engineers are the only people who run down their own business? Gas engineers don't make rules for gas. Have electrical engineers anything so dangerous as a water-slide chandelier? One may put up a swivel gas bracket standing out between a pair of lace curtains, but no rules prohibit that.

In 1886, at Cardiff, 2,000-volt Brush machines were supplying electric lamps in all sorts of places, but he never heard of an accident. In exhibitions, where wooden base switches, &c., were largely used, no fire occurred, although he always thought we should have had one. Mr. Raworth concluded by citing the horrible example of Glasgow, where a policeman may knock at one's door at midnight and demand to see one's marriage certificate.

Another speaker made some remarks on the chaotic state of the subject, and wanted to know when and where the making of rules was going to end. The tenor of his remarks is summed up in his concluding desire that the trade would speak out and have done with this regulating business. Mr. Cottam pointed out that the reason for high insulation was to free the consumer from the trouble and risk of breakdown. Mr. Andrews thought that rules should be of an advisory nature, and not deal with details. He then dealt at some length with the question of earthing. Mr. Sam Mavor remarked that he had never seen an insurance inspector with a testing set of any kind. He protested against the rules that prescribed motors entirely enclosed, and pointed out the risk of heating due to the defective air circulation. Mr. Shoolbred referred to his Bradford experiences, while Mr. Campbell Swinton followed on the lines of Mr. Raworth and Mr. Atkinson (whose remarks are referrrd to above). He thought supply rules atrocious and *ultra vires*. He was glad he had not to live in Manchester, where life would as soon be as undesirable as it appeared to be in Glasgow. Mr. Charles Bright reminded the meeting that high insulation resistance necessarily followed as a mark of quality with a material like rubber, possessing high specific resistance. He then dwelt upon the value of regular electrification in testing rubber insulated cables.

Mr. Arthur Wright spoke on the subject from the point of view of an engineer who did not have rules, and did not want them. He did not consider it in the province of the supply engineer to enforce rules, provided that the conditions of supply were not interfered with. The most important condition of supply was, that no user should take current intermittently, so as to interfere with the general pressure of supply, and the leakage from wiring must not be very great. It was not the province of engineers to make fire rules; the duty of the supply engineer was to keep the pressure constant, and get the plant necessary to meet the supply demands. He assured the meeting that he regarded it as his duty to get as much business as possible, and help wiring on. A natural laugh followed the assertion (and from Mr. Wright, too) that station engineers were very badly-paid people. Some people might prepare rules to satisfy old ladies, but he thought these rules were apt to frighten the public. If engineers kept to their province they would run their plant so as to maintain a constant pressure, and if they had not the plant to do this they had better look after getting it.

Mr. Mordey followed in much the same strain. He believed Manchester has municipal gas supply. Gas is dangerous. Manchester has no municipal gas rules. Why should Manchester have all these electricity supply rules?

Mr. H. W. Miller besought the meeting to take a common sense view of the question. He had, he said, been asked to re-hang a picture in a house he had gone into. He proceeded to remove the existing nail, but was almost knocked down by the gas which found its escape through the hole where the nail had been. He put that nail back, and procuring a new nail hammered it in higher up. His hearers understood him to say that the old nail had been driven into a compo. gas pipe but no leak had been found so long as the nail remained in its place, and the inference was apparently drawn that as no "Institution of Gaseous Engineers" had issued rules against that nail or the pipe wherein it rested, there it might be allowed to remain.

Mr. Berry spoke from the wiring contractor's point of view, and advocated concerted action to bring the framers of divergent rules to their senses and reconcile the different ideas that prevailed as to how wiring should be carried out.

Prof. S. P. Thompson remarked that one large hotel on the Embankment was wired with bare conductors. When that work was completed in De Keyser's, the insurance company was informed of what had been done and were warned that they could either accept it or the policy would be placed elsewhere.

Mr. Crompton, in his reply, stated that he felt like the minister in charge of a Bill. One after another of the fire office inspectors had agreed that there was no apparent difficulty in getting uniformity. Other points had been made by municipal engineers, and if anything had come out, it was the extraordinary figures demanded. The difference had shown conclusively that some attempt should be made towards uniformity. He then appealed to the chairman (Prof. Thompson) for permission to put a motion to the meeting. This was granted, as, although the articles of association prevent any motion being brought forward at an ordinary

meeting dealing with the direction and management of the business of the Institution, what Mr. Crompton desired to bring forward had rather to do with the direction and management of someone else's affairs.

The motion was then put, to the effect that the meeting was of opinion that the Institution should take steps to obtain the general acceptance of the Institution rules, or of a set of rules based on the existing rules, by contractors, the fire offices, and supply companies. This was seconded and resolved unanimously, one speaker suggesting that the rules should be modified, if found desirable, while General Webber proposed that the whole subject should be re-discussed again later in the year, and after preliminary steps towards the end in view had been taken.

Mr. Pigg, on being asked to reply, expressed his desire to forward his remarks in writing to the *Journal*. Mr. Wordingham then took up his defence of the proposals in his paper, and generally replied to the discussion upon it. He said he was prepared to fight, and was glad to see Mr. Drake approved of the general course he advocated. The tests were perfectly definite, left nothing to the discretion of the inspector, and the manufacturer was allowed free access to the tests. He looked upon his rules as wiring rules only so far as they concerned the station. Mr. Bathurst wanted no rules—some people wanted no laws either. Wiring can't be put in as gas pipes are put in. To arrive at his figure for insulation he had measured the insulation of a number of installations well done, and had taken the mean, 50 megohms divided by the number of lamps. He advocated earthing motor frames to avoid low insulation between frame and winding. All rules must be enforced with reason. Those who favoured no rules at all hardly seemed to realise the effect, the flooding of the market with cheap German rubbish, and the jerry wireman would have all his own way.

The meeting then adjourned with an intimation that an extra meeting would be held on February 16th, and that for March 2nd would be cancelled.

CORRESPONDENCE.

Electrical Fittings Censorship.

With reference to the discussion now occupying your columns, perhaps a few words from the manufacturers' point of view might be of some slight service. The present position of the manufacturer is such a difficult one that any system of registration tending to standardise the articles used on the various circuits must be received and welcomed by him with open arms. It indubitably stands to reason that engineers seeing what is necessary for the purpose of safety on one circuit will be influenced to some extent by other persons' experience. At the present time, as is well known, it is a practical impossibility to state with any confidence whether a switch or other fitting will be passed on such and such circuit. Two sister towns on the South Coast, which practically overlap each other, and in which an enormous amount of lighting and other work has been carried out, disagree in every possible way as to what fitting shall or shall not be used upon their various circuits. One might almost think from the experience gained, that if one fitting is allowed upon the one circuit it will immediately be rejected for use upon the other. The question of expense which Mr. Clark raises is but a small one compared with the enormous expense necessary for producing patterns and of carrying stocks of goods to meet with the varied and various engineer's requirements. We have immediately, with other manufacturers of high class goods, at once fallen in with Mr. Wordingham's admirable suggestion. It is self-evident that if the articles are manufactured by practical men for use upon high voltage circuits, they will, in capable hands, immediately be approved. Upon the other hand we do not doubt that a serious blow will be aimed at the contractor who is willing to fit up anything that will pass a preliminary test, so that he may receive payment for his work. Mr. Wordingham's scheme is undoubtedly the severest blow cheap and nasty fittings and the ditto contractor have ever received.

We enclose our card, but as we are not seeking a cheap advertisement at your hands, beg to subscribe ourselves

English Manufacturers.

Cowper-Coles's Electrolytic Cyclic Process.

I have read Mr. Andreoli's letter appearing in your issue of the 10th; I think Mr. Andreoli is well advised in retiring from the discussion, now that his criticisms have been so completely refuted and he has no more questions to ask.

Sherard Cowper-Coles.

The following is the only answer I have to give to the letter from Mr. Cowper-Coles, which appeared in the last number of your journal.

To my knowledge no one before me has used rotating cathodes partly immersed in some electrolyte in order to collect, by means of scrapers, the spongy metal adhering to the cathode when, in consequence of the rotation part of the disc-cathode emerges from the electrolyte. Moreover, my process has been described in several scientific journals and treatises, and up to the present no one has disputed the priority of my system.

D. Tommasi.

The Nernst Lamp.

There is a point in the practical development of this extremely interesting invention, which strikes one as likely to prove of very serious importance. It is one that affects the durability of the lamp which, as you state, is now apparently the one remaining crucial test that it has to pass. It relates to the connections to the refractory filament. Consideration shows that these must be subject to a very high temperature: for the conductivity of the filament substance falls so abruptly with the temperature that practically no grading down of the latter to the ends of the filament appears possible. In the carbon lamp the cementing to the platinum increases the section of filament at the joint so that the actual point of contact is comparatively cool. But when dealing with material which is non-conducting at moderate temperatures, a cool joint is impossible. The connection itself must be almost at incandescent point or the current cannot flow from it.

Supposing the connections be of platinum wire, they must be long, otherwise a lot of heat is conducted backwards from their incandescent ends. In a vacuum carbon cemented joints might perhaps be employed; but we are told that a vacuum lamp is impossible; why, it would be interesting to know. Does the same objection apply to enclosing in an inert gas? At any rate it seems certain that highly heated metallic connections whether in an open or sealed lamp must be a source of trouble. The failure of the platinum lamp points this way.

I am not making this criticism in an adverse spirit. I merely wish to indicate a seeming difficulty, which I hope has or will be surmounted successfully. Much depends upon the way in which the conductivity of these materials increases with the temperature. What sort of relation exists between the two properties? Can it be expressed by a curve, or is the growth of conductivity a wholly abrupt phenomenon uncharacterised by any gradations?

There appears to be here a grand field for investigation, quite apart from practical and commercial considerations. Can you let us know what information is at present available in this direction? The whole subject, in fact, is one replete with interest, and further particulars will, I am sure, be eagerly watched for and welcomed by many others besides

James Whitcher.

LONDON COUNTY COUNCIL.

DRASTIC PROPOSALS CONCERNING PROVISIONAL ORDERS.

SOME important proposals were adopted at the weekly meeting on Tuesday in reference to the 12 applications made this session to the Board of Trade for electric lighting provisional orders. These applications concern the Vestries of Bermondsey, Bethnal Green, Kensington, and Plumstead, and the Lewisham District Board of Works on the one hand, and on the other the County of London and Brush Provincial Electric Lighting Company (three orders), the Blackheath and Greenwich Electric Lighting Company, the Charing Cross and Strand Electricity Supply Corporation, the Smithfield Markets Electric Supply Company, and the Metropolitan Electric Supply Company. Coming now to consider the proposals as affecting these interests, we first reach the question of the transfer of powers.

TRANSFER OF POWERS.

On this point the Highways Committee stated that the clause providing for the transfer of the powers under the orders has been omitted from those applied for by the Vestries of Bermondsey and Kensington, but is inserted in those applied for by the Vestries of Bethnal Green and Plumstead and the Lewisham District Board of Works. In view of the exceptional position occupied by a company (South London Electric Supply Corporation) to which an order granted to a vestry had been transferred, inasmuch as the company has, under the order, only to serve notices and plans of works, and the Council has not power, as in the case of orders granted to companies direct, of approval or disapproval of the works, the Council last year asked the Board of Trade to insert a provision, in each of the orders granted to local authorities, requiring the sanction of Parliament to the transfer to a company of the powers under the order. The Board did not, however, adopt the suggestion, but instead struck out the provision authorising the transfer of the undertaking. The Highways Committee, therefore, thought that it should be suggested to the Board of Trade that the same course should be adopted in the case of the proposed orders for the local authorities of Bethnal Green, Plumstead and Lewisham.

It was also suggested by the Highways Committee that the initial price should be 6d per unit, and that, except with the express consent of the Board of Trade, the system of supply should be by continuous current, as being more satisfactory to consumers than the alternating method of supply.

PROTECTION OF TRAMWAYS.

With regard to the question of protecting the Council's tramways, the Highways Committee expressed the opinion that the Board of Trade should be asked to insert in each of the provisional orders which may be granted, a special clause so as to provide that the electric light mains and works shall not be placed in such positions in the public thoroughfares as, in the event of the Council adopting some system of electric traction for its tramways, will necessitate the removal of the mains to other positions.

This request was first made to the Board as regarded the orders applied for in 1897, but was refused; the Board giving as its reason that the question of the relations between users of electricity for tramway purposes and other users had been fully considered by a joint committee of both Houses of Parliament, which committee had settled a clause to be inserted in all Bills and provisional orders authorising the use of electricity on tramways, and that this clause would apply if the Council were authorised to work tramways by electricity. The request was repeated as regarded the orders applied for last year, but, probably for the same reason, was not acceded to.

The Highways Committee thought, however, that the Board of Trade had not quite appreciated that the clause to which it referred did not give all that the Council required as regards the tramways, and at the request of the committee Earl Russell had consented to confer with the Board of Trade with a view to inducing the department, if possible, to change its attitude in relation to the matter.

THE QUESTION OF PURCHASE.

The Camberwell provisional order, 1896, contains a clause providing that at any time during the first 21 years after the granting of the order, the local authority may purchase the undertaking upon payment of one and a third times the capital outlay incurred by the company plus the sum necessary to make the dividends up to an average of 5 per cent. from the commencement, and after the 21st year upon the same terms, but without the condition as to 5 per cent. dividend, or as an alternative, on payment of the "then value," plus an allowance for goodwill.

Commenting on this matter in relation to the above provisional orders, the Highways Committee said:—"We think it advisable that this clause, which was agreed upon between the Vestry and the undertakers, should be inserted in the orders granted to companies. We are advised that on this particular point the Council has no *locus standi*, and we have therefore directed that the attention of the various local authorities concerned shall be called to it in order that they may, should they consider it expedient, in their own interests, make representations to the Board of Trade with a view to the insertion of the clause in the orders relative to their respective districts. We have also suggested to the local authorities concerned that they should ask that the option of purchase may be exercised at the end of every period of *seven*, instead of *ten* years after the expiration of the first statutory period of 42 years from the date fixed by the order."

THE PRINCIPLE OF COMPETITION.

The question of competition between a local authority and a company, with special reference to the now well-known cases of Bermondsey and Marylebone, was then considered. On this point the Council resolved to inform the Board of Trade that, having regard to the provision in the Electric Lighting Act, 1888, that the grant of authority to undertakers in any area "shall not in any way hinder or restrict the granting of a provisional order to the local authority," the Council were of opinion that the applications of local authorities for orders in respect of their districts with regard to which orders have already been granted to companies, should be acceded to.

We now come to the reverse state of affairs, which the Highways Committee characterise as a matter of even greater importance, as it involves the question of principle whether when public money has been used for the establishment of the supply of electricity within a district, a company should be allowed to establish a competing supply. This phase of the matter does not seem to have been dealt with by the Act. The policy of allowing competition between two companies in the same area has from the first been advocated by the Council and adopted by the Board of Trade in dealing with applications for orders; but the question of allowing a company or companies to compete with a local authority in its own area has not arisen in previous years.

As it is proposed to report further on the question on a future occasion, the Highways Committee thought that in the meantime the proposals of the companies should be opposed, although if an understanding should be eventually arrived at, the opposition could be withdrawn or modified.

AMENDMENT OF PROVISIONAL ORDERS.

As a result of the foregoing expressions of opinion, the Council decided to ask the Board of Trade to insert in the case of the provisional orders sought by the local authorities certain amendments proposed by the Highways Committee, including those dealt with in regard to the transfer of powers, the initial charge per Board of Trade unit, and the protection of the Council's tramways.

With regard to the applications on the part of companies, it was decided (1) to suggest to the Board of Trade that as the local authorities of Battersea, Fulham, Stoke Newington, Hackney, Poplar, and Whitechapel have each been granted orders for their respective districts, and the Vestry of Bethnal Green is applying for an order, the application of the County of London and Brush Provincial Electric Lighting Company for Battersea and Fulham, and the County of London (East) Electric Lighting Orders should not be entertained; but that should the Board decide to allow the company's orders to proceed, as regards all or any part of the areas referred to therein, the Council may have a further opportunity of submitting amendments, and that, having regard to the fact, the Vestry of Bermondsey and the Lewisham District Board are each applying for an order, and also to the fact that the greater part of the other areas included in the County of London (South-East) Order applied for by the same company, is already included in orders granted to other companies, and some of the local authorities of those areas are opposed to the granting of the order, the application of the company should not be entertained.

The Council also decided to ask the Board of Trade to insert amendments in the Blackheath and Greenwich Company's order; to ask that, if granted, the orders sought by the Charing Cross and Metropolitan companies should be brought into conformity with the orders issued in 1890 in respect of the City of London, and to request that the order proposed by the Smithfield Markets Electric Lighting Company should not include the parish of St. Luke, Middlesex, and the Holborn district.

THE WATER POWER OF THE THAMES.

Mr. PARKER moved that it be referred to the Rivers Committee to consider as to instructing the engineer and an expert to report upon the desirability of constructing water wheels or the fixing of floating turbines at the various bridges or the making of reservoirs, and generally upon the best method of utilising the tides on the river Thames for the purpose of motive power adaptable to the generation of electricity. In proposing the resolution the speaker expressed the opinion that the adoption of the motion might result in some good.

The motion was seconded by Mr. THORNTON, but it was not adopted.

BUSINESS NOTICES, &c.

Bankruptcy Proceedings.—Thomas King, electrical engineer, Maidstone, appeared again for public examination at the Maidstone Bankruptcy Court on 8th inst. At the last Court the debtor was ordered to file amended deficiency and trading accounts, and he had done so. The trustee, although not satisfied with the accounts as produced by debtor, was willing to believe that the effort was the best the debtor could make. Debtor was then further examined. Finally he was allowed to pass his public examination subject to signing notes.

At the Birmingham County Court on 9th inst. Thomas Ford, chandelier and electric fittings' manufacturer, Highgate, Birmingham, was adjudicated bankrupt. The first meeting of creditors was held on 10th inst. at the Board of Trade Offices, Corporation Street, Birmingham. The statement of affairs shows: Liabilities—unsecured creditors £2,374 10s. 1d., other creditors (£7,850 6s. 7d., less £4,300 17s. 10d.) £3,279 8s. 9d.; total £5,653 18s. 10d. The available assets are estimated at £460. The Official Receiver, in his report, stated that the debtor appeared to have suffered from a continuation of misfortune; and a creditor added that Mr. Ford's only error was in not pulling up before. Mr. O'Connor said that the debtor's friends were desirous of buying up the assets, and an informal meeting of creditors had agreed to accept £600. No proposition, however, was

made at this meeting, and for the present the Official Receiver remains trustee.

The other day J. E. Liardet came up for public examination before Mr. Registrar Brougham. The debtor described himself as an engineer, of Hyde Park Gate, and returning his gross liabilities at £11,157, of which he expected £5,647 to rank, and his assets at £19,000. It was stated that under the bankruptcy proceedings he had made an offer to his creditors, and a meeting was pending for its consideration. The further examination was accordingly adjourned.

Dissolutions of Partnership.—Messrs. G. F. G. Des Vignes & W. A. Cloud (Des Vignes, Cloud & Co.), engineers, electric yacht and launch builders, &c., Magnolia Works, Strand-on-the-Green, Chiswick, have dissolved partnership by mutual consent. Debts will be attended to by Mr. W. A. Cloud, who will continue the business under the old style.

We are informed that the partnership notice *re* Messrs. Gent and Hurley (in our issue of February 10th) has no reference to the old established manufacturing business of Gent & Co., Faraday Works, Leicester, which is still under precisely the same management and owners as hitherto.

Books Received.—"Telegraphy," by W. H. Preece, C.B., F.R.S. and J. Sivewright, K.C.M.G. Fifteenth edition (thoroughly revised). Longmans, Green & Co., London. 6s.

"The Engineers' Year Book" (1899), by H. R Kempe, A.M.I.C.E. Crosby Lockwood & Son, London. 8s.

"Practical Work in Physics" (IV.—Magnetism and Electricity), by W. G. Woollcombe, M.A., B.Sc. Clarendon Press, Oxford. 2s.

"Nachrichten von Siemens & Halske Aktiengesellschaft." 1898.

Catalogue.—We have received a well illustrated price list (1899) of the manufactures of the Newton Electrical Works, Limited, of Taunton. Open and closed Taunton motors and dynamos for various purposes, also motor starting switches, transformers, and switchboards have each a place in the pamphlet.

Consular Reports.—Those who make a custom of referring to those very useful reports which come to hand from our consuls in foreign parts will be interested in Mr. Brodrick's statement in the House of Commons last week in reply to Mr. Marks. He stated that the utmost pains are taken to secure the earliest practicable publication of these reports, and the average time occupied between their receipt and issue is under a month. In this respect the British reports compare very favourably with those of the United States. The Commercial Intelligence Bureau, which it is contemplated to create as the result of the recommendations of the Commercial Intelligence Committee, will, Mr. Brodrick trusts, secure the marshalling of the facts in the manner desired by Mr. Marks. As regards the form of the reports and the directions as to their compilation, very full and complete instructions, accompanied by skeleton tables and returns, have for some time past been in the hands of Her Majesty's Consuls. These instructions are revised and supplemented from time to time as occasion requires. We are glad that this question continues to receive the attention of the Government. It is highly desirable that the information sent home should be in the hands of the public at the earliest possible moment, but in regard to date of publication, while we may compare very favourably with the United States on this point, we should think there must be something exceptional about a report which takes a month to pass from the hands of the department to the publishing counter. And a good proportion take longer than a month! Perhaps they are tied up with too much red tape!

Covent Garden Theatre.—The Covent Garden Theatre, of which the general equipment has fallen out of date, is to see considerable improvement, both in front of and behind the curtain, and the various works which were under consideration when the building was in Mr. Faber's hands, are not only to be proceeded with at once, but their extent will be materially elaborated. Every possible care is to be taken to modernise the mechanism of the stage, and to tend to the comfort of the audience. Among the difficulties which had to be contended with was the complicated storage of scenery, the absence of the electric light, and the dearth of modern stage appliances, but these defects are to be gradually remedied, and though the time at the disposal of the new owners will be short, they may be relied upon to give the theatre a better equipment than it had last season. The improvements are having the personal attention of the directors, *i.e.*, the Earl de Grey and Mr. H. V. Higgins, who are assisted by Mr. Neil Forsyth, the secretary, and Mr. Edwin O. Sachs, their new technical adviser.

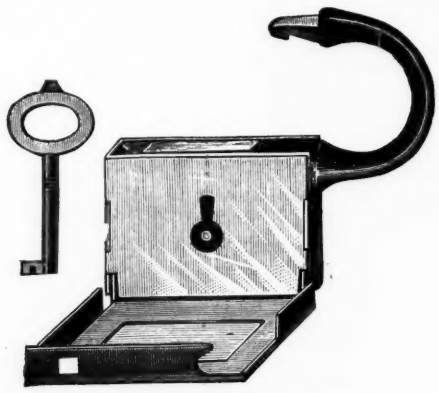
Electric Clocks.—The electric turret clock at the Northern Counties Railway Station, Belfast, mentioned last week, is one of Messrs. Gent & Co.'s patent electric timekeepers, and was erected by Mr. Sharman D. Niell, of Belfast, who is their sole agent in Ireland for these clocks.

Electricity at the Vatican.—The electrical installation at the Vatican is stated to include a number of motors and about 600 lamps.

Free Wiring.—The National Electric Free Wiring Company have just issued three circulars, one of which shows the advantages to a supply authority of having a free wiring contract with the company, another entering into details as to the method of doing business, and a third describing the system of wiring used by the company.

Gear & Miller v. Electrical Cab Company.—At the Wandsworth County Court defendants applied for a new trial, on various grounds, of the above action, in which damages had been awarded to plaintiffs, who were costermongers, for injuries to person, stock, &c. The application was refused by Judge Lushington.

Electricity Meter Padlocks.—Mr. Newman Wilkinson, of 2, Gresham Buildings, Basinghall Street, E.C., has been appointed sole agent in the London district for Tourtel's patent seal padlocks, as



supplied for electrical purposes. The padlocks which we show "open" and "closed" in the illustrations, are intended to supersede the ordinary methods of sealing up electricity meters, demand indicators,

cut-outs, &c., on consumers' premises. The lock can be adapted to any meter, and it is claimed to be impossible to tamper with them without detection, a paper seal being inserted over the keyhole as shown.

The Large Power Schemes.—A Mansfield paper says that Mr. Thackeray, one of the directors of the General Power Distributing Company, has written an important letter refuting, from his point of view, the alleged unfair treatment of the Power Distributing Bill in Parliament. He says:—"The company's object and policy is not to retail electrical current to the small consumers, but to supply it in bulk to Corporations or to large works. They only retain the right to trade direct with the ordinary consumer in case the Corporation unreasonably refuse to allow them to pass the current through the Corporation's own wires. I am confident that the position is misunderstood by the authorities, or they would recognise that the project of the company, far from being the nuisance it is alleged to be, will be of great public advantage to a large manufacturing district like ours. It will constitute a new step in the division of labour, enabling the small master, or even the single workman, to obtain power on tap, and so to produce as cheaply as the large steam factory. Such schemes are no wild idea—they exist by the hundred in every civilised country except ours. We are behindhand because of this mistaken policy of our local authorities to monopolise the electrical business and confine it to the small and uneconomical dimensions of their local areas."

The *Times* says:—"Mr. Stuart Wortley has given notice of his intention to move the rejection of the General Power Distributing Company Bill, the object of which is to incorporate a company for the purpose of supplying electrical energy for lighting and power in an area which includes Sheffield, Nottingham, Rotherham, Lincoln, Doncaster, Chesterfield, Ilkeston, Mansfield, and East Retford. The second reading of the measure, which, it may be remembered, was 'hung up' last July with a view to its being proceeded with in the House of Commons this Session, as having received the sanction of the House of Lords, has been put down for Monday; but as there is opposition, the actual consideration of the Bill will be deferred to a later date. It is submitted that in order to justify the granting of electrical powers within any town already supplied with electricity by the local authority, it ought to be clearly shown that the local authority have failed in their duty, or that they have not been doing their best to develop the undertaking, or that they have been negligent or indifferent to the wants of their towns. In the case of the General Power Bill it is contended that no evidence has been given of any such failure or neglect, and, further, that whilst the promoters have not succeeded in their endeavour to make out a case of special advantage to the districts proposed to be supplied, the large towns mentioned are able to provide the current as well and as cheaply as the company. During the last 50 years the general course of legislation has

been to encourage and foster the assumption by municipal authorities of duties in which the community are interested, and Mr. Stuart Wortley holds that the departure from this principle contained in the General Power Bill justifies him in taking the exceptional course of opposing it on the motion for second reading. The decision of the House in regard to the General Power Distributing Company Bill will establish an important precedent, for at least three other measures now awaiting second reading are drafted upon similar lines, and are opposed upon the same grounds. These are the Lancashire Electric Power Bill, which affects Liverpool, Manchester, Salford, Bolton, Oldham, Blackburn, Preston, Birkenhead, St. Helens, Burnley, Rochdale, Stockport, Warrington, Bury, Wigan, Bootle, Southport, Ashton, Accrington, Macclesfield, Darwen, Widnes, Hyde, Eccles, Rawtenstall, Stalybridge, Bacup, Heywood, Chorley, Middleton, Haslingden, and Mossley; the South Lancashire and Cheshire Electricity Bill, which seeks powers over an area including Liverpool, Bolton, Birkenhead, St. Helens, Warrington, Wigan, Bootle, Southport, Chester, Leigh, Eccles, Widnes, and Chorley; and the Leicestershire and Warwickshire Supply Bill, which affects Leicester, Coventry, Leamington, Loughborough, Warwick, and Sutton Coldfield (Birmingham, Derby, and some other towns are included in the Parliamentary notice, but they have been omitted from the map of the area deposited in the Private Bill Office). There is also pending before the Board of Trade an application for electric powers over another large area in the Midlands, but this is by way of provisional order and cannot at present be dealt with by Parliament. The towns included in this area are Dudley and West Bromwich.

Representatives of 40 urban district councils of Lancashire and Cheshire met in Manchester on Tuesday, and decided to oppose the Lancashire Electric Power Bill. The voting was 32 to 15.

New Car Works.—It is stated that Messrs. G. F. Milnes and Co., L'd., of Birkenhead, have purchased buildings on the site of some old extensive steel works at Hadley, near Wellington, in Shropshire, for the purpose of manufacturing electric tramcars, omnibuses, &c. Messrs. Milnes have also purchased over 20 acres of land adjoining for the erection of extensive workshops, capable of an output of 700 or 800 cars per annum.

New Premises.—Messrs. W. W. Gillard & Co., electricians, have opened premises at 65, Upper Street, Islington, N.

Paisley.—The Parish Council have accepted the estimate of Messrs. Jas. Kilpatrick & Son, Paisley, for the electric lighting and fittings of their new offices. The above firm have completed the installation at the new Museum and Free Library, current being switched on on Tuesday last by Mr. Robert Foulds, manager of the firm.

Pocket-Book.—A very neat and handy pocket memorandum book and an illustrated price list of tubes, &c., comes to hand from Messrs. John Spencer, Ltd., of Wednesbury.

Railway Station Lighting in Ireland.—Messrs. Wm. Coates & Son, Ltd., of Belfast, have in hand the lighting of the Amiens Street Terminus, Dublin, for the Great Northern Railway Company, Ireland. The plant will consist of two Babcock & Wilcox water-tube boilers, two Belliss compound high-speed 100-H.P. engines direct coupled to two Thomson-Houston multipolar dynamos. The lighting consists of 64 arc lamps and 500 incandescent lamps, which will extend to all the goods yards, main station buildings, engine sheds, general offices, refreshment rooms, &c., and will entirely supersede the gas lighting used at present. Messrs. Coates have also lately completed a gas engine installation with 26 arc lamps for the Belfast Terminus of the same railway company, and are just completing the lighting of the Belfast and Northern Counties Railway Company, Belfast Terminus, with 30 arc lamps; also the offices and Station Hotel consisting of about 500 incandescent lamps. These three installations represent the whole electric lighting work in connection with Irish railway stations.

South African Electrical News.—The current issue of the *British and South African Export Gazette* says that the whole of the electric lighting installation of Lourenço Marques, recently inaugurated, was supplied by the Compagnie de Fives, Lille. It includes six dynamos, each with a capacity of 40 kilowatts, 135 volts, 300 amperes and 300 revolutions, a double switchboard, 14 miles of wire, 12 1,500-C.P. arc lamps, and 600 16-C.P. incandescent lamps. An electric travelling crane, three boilers of the semi-tubular type, also three Corliss single cylinder engines with direct condensation, and capable of developing from 225 to 250 H.P., also formed part of the same firm's contract. For the Durban municipal electricity works, an additional Peache engine has just been ordered from Messrs. Davey, Paxman & Co., and the Electric Construction Company will furnish an additional alternator.

Smoke Nuisance.—At Southwark on 9th inst., Mr. Slade gave his decision in the adjourned case of the City of London Electric Lighting Company, Great Winchester Street, who were summoned at the instance of the St. Saviour's Board of Works, for allowing a smoke nuisance at their Bankside premises. There were 10 summonses, each in respect of a different day in January. Mr. Slade said that in deference to the wish of Mr. Passmore, solicitor to the company, he had visited the company's premises and was very pleased with what he saw. The buildings were magnificent, and everything seemed to be in excellent condition. He would not undertake to decide what was the cause of the black smoke arising—whether from the carelessness of the stokers or the inferior quality of the coal. He could not (says the *Times*) accept the excuse put forward on the company's behalf, nor could he overlook the fact that this was the third time that the company had been summoned. The last time they appeared they were fined £5 on each summons, but he should now order them to pay a penalty of £10 and 2s. costs on each summons—total £101.

Theatre Lighting.—We understand that the whole of the electric lighting arrangements for the Bedford Music Hall, Camden Town, which has just been rebuilt, have been entrusted to Messrs. Vaughan & Brown, together with the manufacture of all the necessary stage appliances, switchboards, and the ornamental fittings throughout the house. The same firm will also be responsible for the gas lighting, hot water heating, wrought-iron work, &c. In the dome of the theatre there is a small motor controlled by a change-over switch placed on the stage, and so arranged that the motor can be used for either actuating the sliding roof, or raising the fire-proof curtain. The stage switchboard, which is of marble, has been constructed with a view to rendering the connections at the back extremely easy of access, each slab being hinged so that it can be dropped forward and replaced in a few moments. Outside the house is lighted by means of the firm's patent Vanbe arc lamps, run in series and fitted with automatic cut-out and resistances attached to the lamps. Messrs. Vaughan & Brown, who make a special feature of theatre electrical work, have just completed installations at the following theatres:—Hammersmith Theatre of Varieties; Dalston Theatre; Theatre Royal, Preston; Theatre Royal, Shrewsbury; Coronet Theatre, Notting Hill; "Empire," Bradford; Empress Theatre, Brixton, and the Parthenon, Greenwich.

Verity and Steele's New Patent High Tension Switch and Fuse.—The high tension switch which we illustrate in fig. 1 has been designed with a view to meeting the requirements of central station practice. It is claimed that the switch is one which would break large currents at voltages of the order of

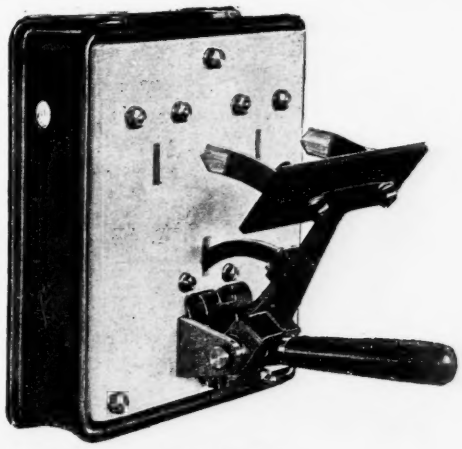


Fig. 1.—Off.

5 000 volts without any risk of arcing, one free from danger to the operator, taking up a small amount of space on the switchboard, and with its parts readily accessible for inspection and adjustment. The principle of the switch may be gathered from the illustrations. No current-carrying parts whatever are exposed, the contact blades

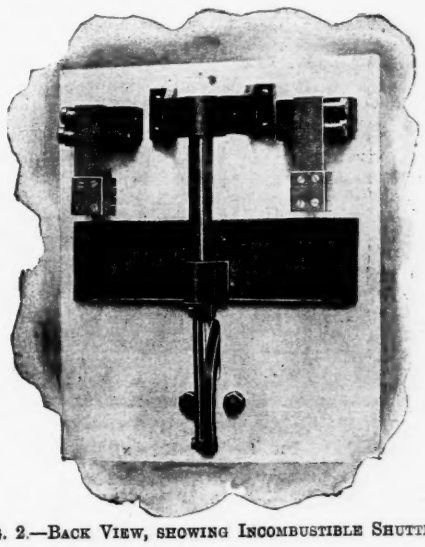


Fig. 2.—Back View, showing Incombustible Shutter.

being effectively shielded by an insulating guard. Any part of the front of the switch can be handled with impunity whether the

switch is on or off. The actual contacts and connections are situated behind the marble slab which forms the base of the switch. When in the "on" position the switch is locked—the same principle being employed as in Messrs. Veritys N.S.C. type—and the circuit can only be broken by means of the handle lever. Simultaneously with the departure of the blades from the contact clips, an incombustible shutter is interposed between the latter and the slots in the marble. Any attempt at arcing is in this manner entirely prevented. The switch is both quick-make and quick-break, and the handle gives it a positive pull off. A curved arm working through a slot in the marble, imparts an upward motion to the shutter, which consequently rises and prevents all arcing. This shutter is made of incombustible material and runs freely on a central guide at the back of the switch. The switches are generally mounted on a cast-iron frame, which can be screwed on to a wall or to an existing switchboard. The switches are made for single and double-pole, and also as change-over switches. The double-pole may be either "parallel" or "tandem."

Figs. 3 and 4 show Verity & Steele's patent high tension fuse. There are not many fusible cut-outs which can be relied upon to break circuits of 2,000 to 5,000 volts with certainty and safety, and for these new fuses it is claimed that they will fulfil all the requirements needed in a safety fuse to break circuits of 5,000 volts without any risk of fire or arcing. The principle is as follows:—A china frame, in shape much resembling an anchor with a handle to it, is provided with two flat metal hooks. The china frame hangs by these hooks on two metal pins projecting through the switchboard, or, in the case of an isolated fuse, through the marble base which is provided. The pins form the terminals of the circuit to be protected. The metal hooks and the detachable frame are held firmly in position by two nuts provided with substantial ebonite handles. The manner in which the fuse is inserted is as follows:—One end of a stranded

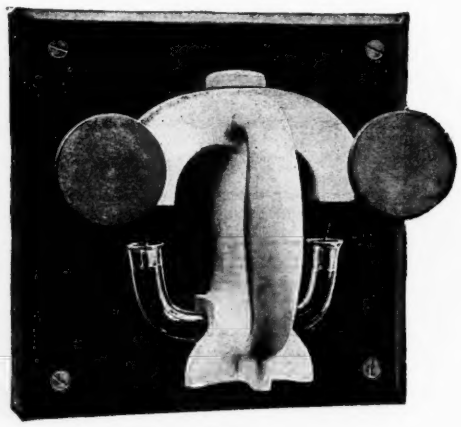


FIG. 3.—SET FOR USE.

copper fuse wire is connected by a suitable terminal screw to one of the contact hooks; the wire is passed through a U-shaped tube and connected to the other terminal hook. The tube, which is filled with special oil, obtains its support from the fuse wire. Should an excess of current occur the fuse wire is severed on one side or the other,

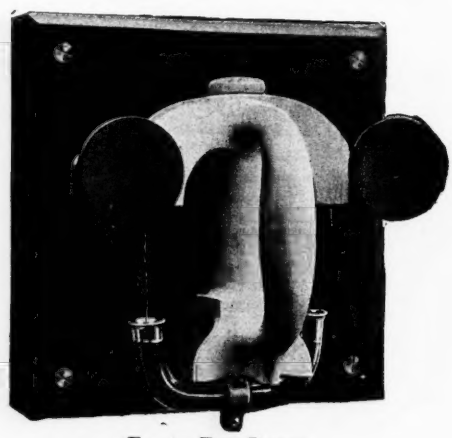


FIG. 4.—FUSE BLOWN.

and the tube, falling by gravity, or in the larger sizes by the tension of a spring, has the effect of submerging the broken end under the oil. The wire is fused in air, and the current at which fusion takes place is, of course, definite. It is claimed that the great feature of the arrangement is that the fused wire is drawn under oil *at double the rate of travel* of the tube. Before finally adopting this pattern of fuse, the firm subjected it to the most crucial tests, one of which was the blowing of a fuse *over fifty times* on short circuit at a very high E.M.F. Another important test which these fuses have received is the gradual raising of the current until the wire, becoming hotter and hotter, finally fuses. The only flash noticeable is a slight flare, comparable to the lighting of a fusee match. Not once was the glass even cracked. The tube is prevented from falling by a silk cord hanging inside the frame from a china plug at the top. It is unlikely that the fuse should blow in both the exposed parts simultaneously. In order to make sure that the wire shall fuse on one definite side, it is usual to lap an extra strand on one side. A spare frame with fuse ready mounted is usually kept in readiness for emergencies. The fuse itself is so designed that when removed from its terminals it will stand in a vertical position. The fuse can also be used as a switch on occasion.

ELECTRIC LIGHTING NOTES.

Bangor.—The Local Government Board has sanctioned the City Council's proposed loan of £14,500 for electricity works.

Barnsley.—A Manchester firm is to advise the Guardians *re* electric lighting for the Workhouse.

Barrow.—The Electric Light Committee is to at once consider the desirability of extending the electric lighting plant in order to be equal to next winter's demand.

Beckenham.—At the last Council meeting a report was presented with regard to the electric lighting tenders, which had been considered by the Council in committee. The Council were recommended to entertain the tender of the British Insulated Wire Company, and that it be referred to the officers to negotiate details and report to a meeting of the Council in committee on Monday last. This was agreed to.

Belfast.—It is stated that on Monday there was an explosion of gas in an electric light culvert, tearing up the pavement for a considerable length and slightly injuring two passers-by.

Bournemouth.—For the purpose of public electric lighting the Bournemouth Council has decided to borrow the sum of £4,516, under the electric light loan sanctioned by the Local Government Board in January, 1895.

Bradford.—A Local Government Board inquiry was held on 9th inst. into the Council's application for a £20,000 loan for electric lighting. The deputy town clerk said that the application was for permission to borrow £20,000, but the Corporation desired to increase it to £21,000. The money was required for the purpose of providing additional machinery to meet the constantly increasing demand for electricity. The particular items for which the money was required were—two 600 indicated H.P. engines, costing about £5,200; two dynamos, £5,500; two new switchboards, £250; four spare armatures, £2,500; two 600-H.P. boilers, £4,100; cast-iron pipes, £1,000; increasing the height of the old chimney shaft at Bolton Road Electricity Works, £200; and one battery of accumulators, £2,250. Evidence was given by Mr. A. H. Gibbings as to the plans of the new machinery.

Bristol.—The Bristol Docks Committee has granted permission to the Great Western Railway Company to lay an electrical cable across the bottom of the lock at Bathurst Basin in place of the cable which now crosses the bascule bridge, and which, owing to constant disconnection, was inconvenient in its working.

Burton-on-Trent.—Five tenders were received for the supply of three new boilers for the electric light works, and that of Messrs. Edwin Danks & Co., Limited, of Oldbury, at a cost of £1,595, has been recommended for acceptance. The recommendation has been referred back to the committee, on the ground that it was reported that Messrs. Danks were not paying the standard rate of wages, in accordance with the conditions laid down by the Council.

Buxton.—The Council has given out a contract for the erection of the electric light station.

Cardiff.—The Infirmary Committee has been advised that the Medical Board has suggested that the new operating theatre should be lighted electrically, and that the current may also be used for cauterisation purposes.

Carlisle.—The electrical installation at the Citadel Station has been completed, and current was switched on on 9th inst. The installation consists of 67 800-C.P. arc lamps for lighting the platforms and approaches, and between 500 and 600 16-C.P. incandescent lamps in the offices, refreshment rooms, &c. The current is generated by five dynamos placed in an arch underneath the island platform. The arc lamps will be lighted from two of them, the third being held in reserve. The two smaller dynamos will be utilised for feeding the incandescents, and will be run when the larger dynamos are at rest. The installation was laid down under the direction of Mr. Fletcher, of the electrical staff of the London and North-Western Railway, Mr. Heap being the resident engineer.

Chichester.—The Council had a discussion last week *re* electric lighting. The Highways Committee has expressed the opinion that the Council should keep the matter in its own hands. The surveyor has been instructed to prepare plans for Scheme "E," which combines a refuse destructor with the lighting plant for the consideration of an expert.

Colchester.—The Town Council has resolved on the Electric Light Committee's recommendation, that Messrs. Siemens Brothers & Co. be asked to furnish the Committee with a monthly statement of the amount expended by them in working the station, &c.; also that whenever it is necessary to temporarily discontinue supplying current in order that service wires may be connected with mains, the borough surveyor send notice of such temporary discontinuance to each of the consumers whose supply will be affected.

Derby.—Sir Henry Bemrose, M.P., is generously providing an electric light installation for All Saints' Church, Derby. The work is in the hands of Mr. Edwin Haslam, of Derby.

Devonport.—A correspondent says that the Devonport Corporation are disposed to give full consideration to the advice that they should buy electricity in bulk from the Plymouth Corporation. The Electricity Committee have been again reviewing the question of a site for an electrical station, with the result that they have come practically to the same conclusion as was reached at the close of the last municipal year, namely, that there are only two practicable situations in the town in which it can be placed. Neither of these is as good as the site of the Plymouth station on the shores of the Cattewater. Inquiries are to be made as to the cost of the two pieces of land, and Prof. Kennedy is then to advise generally on the question of the erection of a station or the propriety of purchasing current in bulk from Plymouth, instead of putting up separate works.

Dewsbury.—Plans for extensions at the electric lighting works have been approved by the Town Council.

Douglas (I.O.M.).—The borough surveyor is to report on various sites for an electric light installation.

Downham Market.—The District Council has appointed a committee to consider the desirability of lighting the town by electricity.

Dublin.—Members of the Council have received circulars from an electrical syndicate offering to take over the electricity undertaking. The syndicate, we learn, proposed spending large sums upon extensions. One Councillor described the letter as "a piece of impertinence," but it will come before the next Council meeting for discussion.

Dundee.—At a meeting of the Tramways Committee last week, plans and specifications for boilers, engines and dynamos for the electric lighting station were submitted by Mr. Tittensor. These were generally approved, and it was decided that tenders should be advertised for.

Fulham.—The Vestry has under consideration tenders for the erection of buildings comprising destructor and boiler house, engine house, &c., in connection with the electricity undertaking, also transformer chambers. The prices range from £26,805 to £22,755.

Garston.—At last week's District Council meeting a letter was read from the Board of Trade with reference to the proposal of the Council to transfer their electric lighting order to the British Insulated Wire Company, Limited, and stating that, having regard to the circumstances under which the powers granted to the Liverpool District Electric Lighting Company were revoked, any proposal the Council now made must receive the very special attention of the Board of Trade. Referred to the Special Purposes Committee.

Gillingham.—The Council is asking Mr. Jasper at what price he would sell his electric lighting undertaking.

Glasgow.—It is stated that the Electricity Department have decided to make an application to the Secretary for Scotland for authority to borrow £500,000 to meet the expenditure necessary for the great development of electric lighting throughout the city which they have now in hand. This will bring their total borrowing powers up to £700,000, as they borrowed £100,000 in 1892 and a like sum in the following year.

The Electricity Committee has considered the proposal by the Kelvinside Electric Company to sell their business and Parliamentary powers to the Corporation. The sum asked, including the cost of plant, installation, and interest, was £48,000, but the Committee recommended that an offer of £30,000 be made.

Greenock.—The Police Board has adopted the Hunter Place site for electricity works, and passed plans, &c., prepared by Mr. Fedden, the electrical engineer. Tenders are being invited for the plant.

Gloucester.—At a recent meeting of the Electricity Supply Company, Mr. Hammond reported that he had arranged a number of details with the various contractors, and that representatives of Callenders' Cable and Construction Company, Limited, were then in Gloucester taking exact measurements, and making the necessary arrangements for laying down the mains. He also reported that, after carefully considering the detailed plans of the India-Rubber, Gutta-Percha and Telegraph Works Company, Limited, for the engines and dynamos, he strongly recommended a re-arrangement which would shorten the steam pipes, and avoid the necessity of carrying them over the dynamos; but as the alteration would involve the making of new patterns and other expenses, the company required an extra payment of £75 for making the suggested alteration to the two sets of engines and dynamos. The committee recommended that the suggested modifications be approved, and the additional cost sanctioned. Mr. Hammond also submitted a specification for the condensing plant. The Council approved the specification, and decided to advertise for tenders.

Greece.—La Société Electrique de la Mediterranée (Thomson-Houston) is establishing a water-power driven central station near Patras for the electric lighting of Patras, Aegion, and Kalavryta.

Hampstead.—The General Purposes Committee of the Hampstead Vestry has reported against the Central Electric Supply Company, Limited (Powers and Works in Marylebone) Bill, and has communicated with other local authorities in order to organise a joint opposition to the measure. The Lighting Committee has also reported that the amount of the electric consumers' accounts for the quarter ended at Christmas last was £8,312 12s. 8d., as compared with £5,892 7s. 11d. for the corresponding quarter of last year, being an increase of 41 per cent.

Hebden Bridge.—It is proposed to light the Salem Wesleyan Chapel by electricity.

Holborn.—Various tenders for the electric lighting of the Guardians' board room have been referred to committee.

Ingleton.—A public meeting has been held at Ingleton (West Riding) for the purpose of considering the advisability of forming an electric light company. A Manchester engineer has estimated the probable cost, and states he could supply 50 street lamps and 1,000 private lights with a capital of £2,000, and enable a dividend of 6 per cent. to be paid. It has been decided to form a company with a capital of £2,500 in £1 shares. A working committee will canvass the town to ascertain what shares would be taken up.

Keighley.—A committee recommends the Council to oppose all the large electric power schemes.

Kensington.—The Vestry have decided to abandon their application for powers to supply electricity in the parish, and to support by petition the Kensington and Notting Hill Bill, which confers powers upon the Notting Hill Electric Lighting Company, Limited, and the Kensington and Knightsbridge Electric Lighting Company, Limited, to construct the works for lighting the streets of Kensington.

Kingswood.—The streets of Kingswood, near Bristol, are no longer illuminated by incandescent electric lamps, for the works have been taken possession of and duly padlocked by mortgagees. We have on many occasions mentioned that the negotiations for the purchase of the undertaking by the District Council had not come to anything definite. The company claims that the Council has failed to fulfil its agreement to purchase, and only a few days ago the Council informed the company that it would neither purchase the works nor adhere to its agreement for the public lighting after June 24th. It seems that the company wanted £3,000 for the undertaking, and the Council refused to pay more than £1,250, as they were advised it was not worth more. The syndicate say that the delay in purchase has been caused through no fault of theirs, but in consequence of repeated requests by the Local Board for time to enable them to borrow the money in order to settle the purchase, which was at the price offered by the Board themselves, and was at about one-third of the original cost of the installation. "A writ has been issued against the Local Board for damage for breach of contract, and any responsibility for inconvenience, accident, damage, or loss to any inhabitant in consequence of the non-supply of light must rest upon the local authorities."

Leeds.—The Lighting Committee recommends the purchase of an additional boiler at a cost of between £2,000 and £3,000.

Leith.—Asked as to when the electric light would be available, Bailie Manclark said a few days ago that there had been a slight hitch on putting on the light. He thought that the contractors were responsible until the light was turned on in a thorough working order.

Leyton.—The engineer reported last week that the capacity of the station when finished would be 16,000 lights. The number connected and applied for was 14,392, making it possible for 1,308 more lights to be connected before further extensions are carried out. There were 6,580 lamps connected during the past year. The Committee have directed the engineer to prepare and submit a scheme for the further extension of the buildings, machinery, and plant.

Lincoln.—A report of Mr. Vesey Brown having been considered, the Council has decided to empower the Electricity Works Committee to obtain tenders for engines, dynamos, motors, boilers, and fuel economiser for the proposed additions and extensions, and that the electric cables be laid in the streets along the several routes referred to in Mr. Brown's report.

Liverpool.—The Local Government Board has sanctioned the borrowing by the Corporation of £44,000 for electric lighting purposes. The Liverpool Chamber of Commerce has asked the Electric Committee to appoint a representative to act on a special committee to be formed to consider the question of a proposed electrical lightning express railway between Liverpool and Manchester.

London.—The St. Olave's Board of Works will offer no objection to the proposed amended form of consent to an extra high pressure being given by the London Electric Supply Corporation.

Mansfield.—The Council will oppose the Bill of the General Power Distributing Company.

Morecambe.—The charges for lighting current are to be reduced from April 1st.

Margam (Glam.).—The Urban District Council decided on Monday to adopt a scheme of electric lighting for a portion of their district at an estimate cost of £6,500, to be raised by loan, repayable in 25 years.

Newport.—At a recent meeting of the Electricity Committee, the office manager submitted his report for the quarter ended December 31st, 1898, of which the following is a summary:—

Period.	Total No. of consumers to date.	Total number of lights connected (including arcs) equivalent to 8 C.P. lamps.	Units to be paid for during the quarter (including arcs).	Cost of generation and distribution per unit.	Total costs (not including sinking fund and interest).	Total revenue (including meter rents).
					£ s. d.	£ s. d.
Quarter ended Dec., 1898.	264	21,483	Inc. 83,604 Arc 35,624 119,228	1·88d.	936 4 10	2,164 10 5
Corresponding period last year	186	16,545	Inc. 59,194 Arc 34,554 93,748	1·99d.	773 16 2	1,606 2 5

The office manager's canvass during the month showed that the orders for new connections were equivalent to 1,045 8-C.P. lamps, bringing the total number of lights connected and on order up to the equivalent of 23,743 8-C.P. lamps. This includes 800 8-C.P. lamps for the new "Empire." It having been reported that the Lighting and Traffic Committee's attention had been called to the fact that the arc light at the corner of Harrhy Street had been out for several nights in succession, it was stated that the converter had failed, and that the whole of the spare converters were in use at the time. It was resolved that a larger number of spare converters be kept ready for use. Applications by different insurance companies asking to be allowed to submit terms for insurance against a breakdown of machinery, and against loss of profits by reason of the works being stopped owing to a fire, were received. It was resolved that the Committee do not consider insurance against such risks necessary. With reference to Mr. Taylor's claim for compensation in respect of damage to his business by the working of the machinery at the electric light works, correspondence having ensued it was resolved that the town clerk reply to Mr. Taylor's solicitors denying that there was any error in the statement that Mr. Taylor had agreed to the terms referred to at a certain interview, and pointing out that unless the original proposal which was made without prejudice be accepted, Mr. Taylor must take his own course, and any action which he might think fit to bring would be defended, as the new terms suggested are out of the question. The borough treasurer submitted an estimate of the Committee's income and expenditure for the year ending March 31st, 1900, which, after making provision for the necessary payments to sinking fund and the interest upon capital during that period, shows a small surplus. No contribution from the rates is therefore asked for.

Neyland.—The Parish Council is considering an electric lighting scheme to provide 16 1,000 C.P. arc lamps. The cost of the scheme is put at £1,000, with £80 to £90 annually for upkeep, &c.

Oswestry.—The proposal to purchase the undertaking of the Oswestry Electric Lighting Company was recently referred to the Watch Committee to conduct negotiations and engage expert assistance if necessary. The Electric Lighting Company are lighting the centre of the town with arc lamps free of cost, during the month of February.

Paignton.—The District Council will apply for a provisional order, and negotiations will then be opened with a company for the transfer.

Penarth.—The District Council has written declining an offer of the Penarth Electric Light Syndicate of the provisional order obtained by them. It was decided to co-operate with the Urban District Council Associations in petitioning against the National Telephone Company's Bills.

Plumstead.—Last week the Vestry adopted a report of the Electric Supply Committee, who having visited several electric lighting stations, recommended that the Brighton installation be taken as the type for adoption in Plumstead, and that it be worked independently of a dust destructor. If a destructor should be erected by the Vestry, any effective supply of steam, the Committee suggested, should be debited to the Electric Supply Committee at an agreed price. These recommendations would involve a greater initial outlay than a plant of the Leyton type, and the Committee therefore recommended that the amount of £30,000, already sanctioned by the Vestry and specified in the application for a provisional order, be increased to £50,000. They also recommended that the Marsh site be adopted for the central station.

Plymouth.—The borough electrician has reported that the cost of fitting up the markets with electric light would be £300, the annual cost of current being £90. The Council has resolved to proceed with the work, and the electrical engineer is also to estimate the cost of lighting the Council chamber.

Prestwich.—It is on the cards that Manchester may supply current for electric light and traction to Prestwich. A deputation from the District Council will shortly wait upon Alderman Higginbottom of the Manchester Electricity Committee.

Redditch.—The Electric Light Committee proposes charging 5½d. per unit to householders and shopkeepers, 5d. to churches, chapels and hotels, and motive power 3d. per unit.

Rotherhithe.—A member of the Vestry last week gave notice that he would move to consider whether to apply for a provisional order. Another member will move that an expert be consulted to guide the Vestry in the matter, also that dust destruction be considered in connection with the scheme.

Rothesay.—The Town Council has agreed to adopt an electric lighting scheme for the front of the town at an estimated cost of £1,800.

Sheffield.—A proposal to provide an independent engine for the electric lighting at the Lumley Street destructor has been referred back to committee by the City Council.

Shrewsbury.—At the meeting of the Shrewsbury Town Council on Monday it was reported that some difficulties had arisen in regard to the completion of the purchase of the electric lighting works from the existing company, and that the final settlement would demand some time.

The Shrewsbury Town Council on Monday decided to petition Parliament against the Bill of the Electric Power Distributing Company.

South Shields.—The Electric Committee's report showed that for the three months ending December 31st, 1898, the increase in sales was £1,035 14s. 8d., and that during January the sales had still further gone up.

Southampton.—The Board of Trade has asked for the Council's observations on Major Cardew's report upon the recent electric shock fatality.

The County Council has resolved to lay a main to the new isolation hospital for lighting. The cost of wiring and fitting the hospital for 392 lights would be £650, and tenders are to be invited for this in accordance with the architect's plans.

Stirling.—Last week the Police Commissioners resolved to ask sanction for a loan of £30,000 for electric lighting. The anticipated immediate expenditure is only about £24,500. Prof. Kennedy has reported upon the tenders submitted, and recommended several for adoption. These the Commissioners resolved last week to accept. Various memorials are being sent to the Secretary for Scotland to the effect that the water-power scheme considered some time ago should not have been abandoned, but should have been adopted instead of the present proposal. The Commissioners are also memorialising to the effect that they consider that the steam-power scheme adopted will best meet the needs of the town.

Swansea.—The Corporation has approved plans and estimates for electric lighting, and an amended application is to be made to the Local Government Board for sanction to raise a loan of £54,648 for the purpose.

Walsall.—The Electric Lighting Committee reported that the number of consumers supplied on the 31st ult. was 139. The annual financial statement in respect of the electric lighting undertaking shows a loss for the past year of £279 3s. 11d.

Warrington.—The Guardians' Infirmary Committee has been inquiring into the matter of heating the infirmary and workhouse buildings and lighting by electricity. It has collected information from other towns where similar buildings have been lighted. It was stated that at the Mill Road Infirmary, Liverpool, there were two high pressure boilers, three dynamos, one booster, and 60 accumulators. The total number of lights which had been wired for was 1,340, and the total cost of the plant was estimated to be between £6,500 and £7,000. At £7,000 the cost would be £5 4s. per light. The wires were all laid in steel insulated tubes. It was ascertained that the present cost of lighting the infirmary with gas was £920 per annum, and that the decoration cost about £350 per annum. It was estimated that the decoration would with electric light last four years without renewal, and that a saving of 70 per cent. in respect of decoration would be made. The architect is going into the question of cost for the Warrington Infirmary, &c.

Mr. A. H. Preece recently attended before the Electric Lighting Committee and gave a full and elaborate explanation of the matters mentioned in his report of December, 1898.

Whitby.—A Committee recommends the Council to take in hand the electric lighting of the district. Mr. W. H. Preece has been interviewed, and he is to be retained to prepare a report.

Whitefield.—The District Council has received a circular from the Lancashire Electric Power Company setting forth their scheme. The Council has decided to issue a circular asking how many residents and mill owners are desirous of having the electric light.

Wirral.—The Lancashire and South Lancashire Electric Supply Companies have given notice of intention to apply for Parliamentary powers to supply Birkenhead and district with electricity.

Worthing.—At a Council meeting on Tuesday, Councillor Ovenden, in moving the adoption of the report (see last week's ELECTRICAL REVIEW), said it did not follow that they would expend the

whole of the money they wished to borrow, and for the moment they were not committed to any definite scheme. They had a site in the centre of the town (the disused waterworks), which all the experts who had seen it declared to be an admirable one for the purpose of a generating station. Alderman Piper proposed that the whole question be referred to a joint committee of the Electric Lighting Committee and the special committee on the lighting of the town to consider and report to the Council in committee. Ultimately it was resolved that it would save time if they had a special Council meeting in committee to consider both the Electric Lighting Committee's report and the report of the Gas Lighting Sub-committee.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Aberdeen.—The Tramways Committee recently recommended that tenders be invited for eight double-decker electric cars used at Glasgow. As the Committee is to present a report regarding the system of traction to be employed, the matter was deferred until that statement had been submitted.

Bath.—It is stated that there is a second company anxious to establish electric tramways in the town. The Committee of the Corporation who are dealing with the matter have resolved that if there are to be electric trams in Bath they must be under the control of the Corporation. They have decided to gather information from other towns where municipal trams are working.

Birmingham.—The Public Works Committee have issued a report upon the tramways question, which will be considered by the City Council on March 7th. The document, which includes numerous tables, embodies a report of a sub-committee appointed to obtain information as to the working of tramways in other towns. This sub-committee addressed a series of questions to 30 of the principal towns of the United Kingdom. In those which have a population of 200,000 and upwards the Corporation own and work the lines—Bradford, Glasgow, Leeds, Liverpool, Nottingham, and Sheffield. At Bradford the Corporation now work nine miles, and intend to take over and work all the other lines (21½ miles) on the expiration of the leases in 1903. In Nottingham the Corporation purchased the tramways in 1897 for £80,000. At Belfast, Bristol, Dublin and Leicester, the lines are owned and worked by companies, while at Edinburgh, Hull, Manchester, Newcastle-on-Tyne and Salford, the Corporations own the lines, but let them to companies to work. A table concerning the municipally-worked tramways shows that at Bradford electric trolley traction is employed, and there has been a capital expenditure of £117,237. At Glasgow, worked by horses except a short length of electric trolley, the capital expenditure has been £1,010,765; and there was a net profit last year of £44,434. Leeds horse trams, being converted into electric trolley, have a capital expended of £379,369, and show a net profit of £144. £5,564 was realised in the previous year, but last year there were increased sinking fund charges on lines not brought into full working. Liverpool horse trams, with experimental length of electric trolley, have a capital expenditure of £889,711, and there was a profit last year of £9,553. The lines have been worked by the Corporation since September 1st, 1897, when they bought the remainder of the company's lease, plant, &c., for £567,375. At Nottingham the conversion of horse tramways into electric trolley is in contemplation. There are no particulars as to profit. At Sheffield horse tramways are being converted into electric trolley. The capital expenditure has been £159,377, and last year's net profit was £15,183. In regard to motive power, the sub-committee report that they inquired from the principal towns visited by the deputation from the Committee in 1897 as to any change or development which has taken place. They are informed, however, that, while there have been some modifications and improvements of a minor character, there has been no material alteration of system. It is evident that, as far as Birmingham is concerned, the question of traction does not immediately arise, and before it becomes necessary for the Council to come to a decision on the subject, it is possible that new inventions and improvements will be available. It is true that many of the Corporations which have recently obtained powers for the working of their tramways, anxious to dispense with animal or steam power, have constructed, or are about to construct, tramways on the overhead electric trolley system. On the other hand, in New York the construction of underground electric conduit is being considerably extended. The Public Works Committee has decided to recommend municipalisation. A financial paper reminds its readers that the undertaking of the old Birmingham Tramways Company was purchased about three years ago by a Canadian and London syndicate on the basis of a payment of £10 per ordinary share, which had fallen at one time to about £3. A new company was then floated, and the £5 shares have advanced to £6 15s. The capital of the present company is £1,000,000. At present electricity is used on one of the eight routes, the cable system on another, and steam on the remainder.

Bolton.—The Corporation have recently placed with Messrs. Dick, Kerr & Co., Ltd., the complete order for electric motor cars and equipments for their new lines. This order, which is stated to be the largest so far placed in any municipality in Great Britain, covers 70 motor cars with trucks and electrical air-brake equipments. The car bodies are to be built at the works of the Electric Railway and Tramway Carriage Works, Limited, at Preston. They will be of what is known as the improved Preston top-seat type, designed to seat 51 passengers. They will be provided with drop-sashes for the windows, and a number of other detail departures from existing practice with this type of car, which it is claimed will vastly improve the appearance of the car itself and the comfort of the passengers. The electrical equipment of each car will consist of two 33 S motors of Dick, Kerr & Co.'s standard type, with two solenoidal blow-out controllers and the necessary subsidiary appliances. The trucks will be of the Brill 21 E type, provided with powerful ratchet hand brake. Each of the 70 cars will also be equipped with geared axle-driven air compressors and equipments of the Standard type, the same as supplied by Messrs. Dick, Kerr & Co. to the Corporation of Liverpool and the North Staffordshire Tramways.

Bristol.—At the meeting of the Tramways and Carriage Company on Tuesday the chairman said that their working expenses had decreased from 75·33 to 71·31. The chairman then alluded to the conversion of the horse lines into electrical lines now going on, and said the directors intended to open the line which ran from the centre of the city past the railway station and on towards Wells Road without waiting for the completion of their new power house at Counterslip. The line would be worked from the present power house at St. George and there would be also opened and worked from their power house, a short connecting line from the present electrical tramway in Old Market to the tramway to the railway station. It was hoped that these lines might be at work in July. As to the other parts of their scheme, they were being pressed forward, and so was the new power house, but it could hardly be hoped that the whole would be ready and the machinery installed by the end of the year. The directors believed that at the end of the year the completion would be near.

Cheltenham - Cleeve Hill. — The Prestbury Parish Council will oppose this electric tramway scheme.

Colne.—The sub-committee has consulted with Mr. Pritchard, electrical engineer, of Birmingham, who had furnished a report on his inspection of the district proposed to be served by the light railway, and also with his views thereon. The sub-committee has since asked that further powers might be granted in considering such report and the subject generally, to obtain such further expert advice as they may deem advisable in completing their scheme to submit for the Council's approval. The Council has empowered the sub-committee to act in the best manner possible.

Devonport.—We are informed that the negotiations for the joint purchase of so much of the Provincial Tramways Company's several undertakings as lies in Plymouth, Devonport, and East Stonehouse, have come to an end. This is less the fault of Plymouth and Devonport than of East Stonehouse, which is sandwiched between the two boroughs, and wanted terms and conditions far too exorbitant from the two other towns.

Edinburgh.—The Edinburgh and District Tramway Company have notified the Council that they will not at present take any action in regard to the proposed light electric railway between Edinburgh and Musselburgh.

Finland.—Messrs. Kummer & Co., of Dresden, have secured a contract to convert the horse tramways in the town of Helsingfors, Finland, into electric lines. The order comprises 30 motor tramcars, and the equipment of the generating station with three boilers, three 230-H.P. vertical compound engines, and three 180-kilowatt continuous current dynamos, &c.

Gateshead.—In their report of last year, the directors of the Gateshead and District Tramways Company state that the negotiations with the local authorities in connection with the agreement between this company and the British Electric Traction Company, Limited, to which reference was made in the last report, have progressed so satisfactorily that a Bill has been deposited in Parliament embodying the arrangement come to.

Glasgow.—It is stated that as a precautionary measure the Chief Constable is to be authorised to provide the policemen on the Springburn and other electric tramway routes with India-rubber gloves for use when occasion arises. It is also proposed that the constables on these routes be provided with keys for the switch boxes, so that they may be able to turn off the electric current when necessary. It is suggested by the Glasgow *Evening News* that by and by the members of the force will be expected to take Lord Kelvin's electricity course at Gilmorehill.

Grimsby.—The Corporation decided to oppose the Great Grimsby Street Tramways Extensions Bill. The company has promised not to use electric power in Grimsby without the consent of the Corporation.

Ipswich.—The Council have decided to withhold assent to the Ipswich Electric Tramway Order, 1899, for tramways extension and transfer to the Drake & Gorham Electric Power, &c., Company, with the view of acquiring the undertaking themselves next year. It has been referred to the Parliamentary Bill Committee to negotiate for the purchase of the tramway undertaking by agreement, and to report thereon to the Council in due course. Prof. Kennedy is preparing plans for an electric lighting installation, and this is put forward as an additional argument in favour of municipal control of electric tramways, the two schemes to work hand in hand.

Leeds.—On the Headingley portion of the tramway route the electrical standards have been placed in position nearly as far as the Oak. On the Chapeltown section they have reached the bottom of Mitchell Hill. From Buckingham Road to the Oak, at Headingley,

the line is to be doubled. Twelve of the new electric cars are now in course of equipment by the British Thomson-Houston Company. It is anticipated that they will be ready for running by Easter. The total number of electric cars on order is 50. On the Headingley-Chapeltown section each "electric" will carry 51 passengers, as against 34 by the large cars, and 18 by the small ones at present. Trailer cars will be employed as required.

Liverpool Overhead Railway Accident.—Lieut.-Col. Yorke, reporting on the accident that took place on December 20th at Dingle Station on the Liverpool Overhead Electric Railway, whereby a train collided with buffer stops at the end of the station, says the driver seems to have been incapacitated shortly before entering Dingle Station from the due performance of his duties from some cause or other, and to this fact the collision must be attributed. The absence of an emergency brake valve deprived the guard of the control of the Westinghouse brake. The collision might have been averted had the guard been able to apply the air brake.

London County Council and Electric Traction.—Last week Mr. J. W. Benn informed the Council of the working of the Council's tramways since they were taken over on January 1st. He added that with regard to electrical traction, they were advised that under one of the company's Acts they had power to at once proceed to institute electrical traction on the south side of the river without obtaining further Parliamentary power.

Lowestoft.—A local paper says that the electric tramway scheme is to be proceeded with, property owners having been served with notice.

Newcastle.—A local paper says that the new Tramways Committee have changed their minds somewhat over the tram question. It will be remembered that they recommended the trolley system throughout. They are now stated to recommend the use of the surface contact system for Granger Street. At Wednesday's Council meeting, Councillor Cail, the chairman of the New Tramways Committee, was to move:—"The confirmation of the report of that Committee recommending the adoption of the overhead trolley system of electric traction on all tramways, with a proviso that, while the Council adopt the overhead system of electric traction for their tramways generally, the overhead system be not constructed in the streets in the centre of the city until the Council have considered and decided whether in those streets some system of electric traction other than overhead traction is practicable to be worked in conjunction with the overhead system in the other streets upon the tramway routes; and that the New Tramways Committee be requested to consider the question and obtain the opinion of the city engineer and of an expert upon the subject, and report thereon to the Council as early as possible."

Newcastle-under-Lyme.—Plans submitted by the British Electric Traction Company, Limited, for a tramway extending from the top of George Street, through the main thoroughfare of the town, to the top of London Road, have been approved, with the exception that in Brunswick Street there should be only a single line and span wires.

Portsmouth.—The Town Council on Tuesday dealt with the report of the Tramway Committee, some of whose members had visited Willesden, Dover, Rouen and Paris, to inspect the methods of tram traction in vogue there. The objections to the several systems—steam, compressed air, gas, cable, conduit (electrical), and surface contact were explained by the ex-Mayor, Mr. H. Kimber, chairman of the committee, who then stated that the committee were perfectly unanimous in favour of the overhead trolley wire system. The members were much impressed by the simplicity of this system, and also by the control the conductors had over the cars. A speed of eight or nine miles an hour could be easily attained, and the car be brought to a stand within its own length. From inquiries he thought that they could construct their lines in Portsmouth for the new system in 10 months. After a brief discussion the report was carried unanimously.

Russia.—A contemporary says that the Ministry of the Interior is at present considering the question of building a network of electric railroads in Riga, Russia. The Town Corporation has already taken this matter in hand, and the Ministry has expressed its willingness to support the town by allowing a loan for the above purpose on profitable conditions. The cost of building the electric railroads in Riga has been estimated at £160,000.

South Staffordshire.—Last week the Wednesbury Town Council resolved to oppose the Bill of the South Staffordshire Tramways Company. The Darlaston Urban District Council and the Coveley Urban District Council have each passed resolutions to oppose the South Staffordshire Tramways Bill and the application of the British Electric Traction Company for further power to extend the tramways.

Southport.—An extraordinary general meeting of the Southport Tramways Company, Limited, was held at Donnington House, Norfolk Street, Strand, London, on the 13th inst., Mr. E. Garcke presiding. The chairman moved the following resolution:—"That the Bill now being promoted in Parliament, intituled a Bill to empower the Southport Tramways Company, Limited, to work the tramways by mechanical power and for other purposes, be and the same is hereby approved, subject to such additions, alterations, and variations as Parliament may think fit to make therein." The chairman said that the object of the resolution was to authorise the introduction of a Bill into Parliament enabling the Southport Tramways Company to work their tramways by electricity. A much better service could be given if electric traction were adopted. It was the desire of the directors to improve the service in every way possible. With that view they were promoting this Bill in order to obtain the necessary power to adopt electric traction. The Southport Tramways Company was now supported by the British Electric Traction Company, who were likewise interested in the Birkdale and Southport Tramways Company. They were in a position, therefore, to bring about the working of the two systems upon uniform methods. It would be a very great pity not to carry this into effect at the earliest possible date. The resolution was adopted.

Torquay.—The establishment of the refuse destructor at Torquay has been attended with great success. A report presented to the Town Council on Wednesday by the borough engineer (Mr. H. A. Garrett) shows that the cost of collecting and burning refuse in December was only 3s. 6½d. a load, as compared with 4s. 2d. per load paid for collecting and carting it to a tip in December, 1897. After allowing £28 7s. per month for interest and sinking fund on the outlay, there was a net gain of £7 19s. 2d. on the work of the destructor, while sufficient steam is generated to light the works and three adjacent public roads by electricity. A battery of accumulators is to be put in at a cost of £400 to carry out this recommendation.

Tunstall.—The Council has affixed its seal to an agreement with the Potteries Electric Traction Company, by which the company undertakes to complete the whole of the tramways in the town before April 3rd, under penalty.

Underground Electric Railways.—The chairman of the Great Northern Railway Company, referring to the question of suburban traffic, told the shareholders that it was proposed to deal with it by means of light trains worked by electricity on underground lines, and the remedy, he thought, was an ideal one. The proposed road would run from Wood Green, through Finsbury Park, Holloway, King's Cross, Holborn, and thence to the new station which the County Council desired to make. The Bill was being promoted by persons having great interest in the Great Northern Railway. For four-fifths of the distance it could be constructed on Great Northern property, and its interests would be identical with those of the Great Northern Company, who would have a majority on the board. The company would be separate.

Walsall.—The General Purposes Committee on Monday recommended the Council to endeavour to acquire by agreement with the South Staffordshire Tramways Company, on reasonable terms, the tramways within the borough, with the exception of the cars and power house, and to grant a lease of the lines to an approved company at a certain rental sufficient to secure the Corporation against loss in respect of interest and sinking fund, and the outlay for the maintenance of the lines, poles, trolley wires, and cables. The Corporation, it is suggested, should have the right to furnish the current for running the cars at a price to be arranged. It is further suggested that a sub-committee be appointed to conduct the negotiations. The Council adopted the Committee's recommendations.

Wolverhampton.—The directors of the Wolverhampton Tramway Company in their annual report announce that a provisional agreement has been entered into with the British Electric Traction Company for the sale to that company of such portions of the tramway undertaking as are outside the Corporation area, subject to the company being able to obtain Parliamentary powers for the alteration of the gauge of the tramway, and to use electrical power in lieu of horse traction. A Bill for this purpose has been deposited.

TELEGRAPH AND TELEPHONE NOTES.

The African Trans-Continental Telegraph.—The *Times* Cairo correspondent says that Mr. Cecil Rhodes has had an interview with Lord Cromer in connection with the Egyptian rates to be charged on the trans-Continental telegraph line. It is stated that while in Egypt he will make arrangements for the transmission southward of the iron poles to be used in the construction of the telegraph line.

American Pacific Cable.—We understand that the United States gunboat *Ranger* is now being fitted out in San Francisco to survey route from Hawaii to Japan for the American Pacific cable.

Pacific Cable.—In the House of Commons on Tuesday, Mr. Hogan asked the Secretary of State for the Colonies whether any decision had yet been arrived at by the Imperial Government, in co-operation with the Governments of Canada, Australia, and New Zealand, in reference to the construction of a Pacific cable, having regard to recent important international developments in that ocean. Mr. Chamberlain replied that no decision has yet been arrived at.

The Telegraph Wire Export Trade.—If the figures given in the Board of Trade returns for January last may be relied upon, the past month has been one of the most active as regards the exportation of telegraph material and apparatus connected therewith, from this country, that has ever been recorded. The value of the shipments during January is given as no less than £311,466, which compares with only £41,250 in the preceding month and £37,929 in January, 1898. Last month's total is nearly equal to a third of the aggregate shipments last year.

Telegraphic Communication with Wei-hai-wei.—Replying to a question in the House of Commons on Monday, Mr. Goschen said that the important subject of telegraphic communication with Wei-hai-wei has not escaped the attention of Her Majesty's Government, but he had no authority as yet for making a statement on the matter.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Amazon Company's cable—		
Cable beyond Gurupa ...	June 11th, 1898 ...	...
New York-Hayti ...	Feb. 10th, 1899 ...	...
Dakar-Bathurst	Feb. 9th, 1899 ...	...
Paramaribo-Cayenne ...	Feb. 10th, 1899 ...	...
Landlines.		
Lines near La Paz, Bolivia...	Feb. 1st, 1899 ...	...
Communication with interior of Madagascar ...	Feb. 5th, 1899 ...	Feb. 8th, 1899.

The U.S. and Cables to the Philippines.—President McKinley has sent to Congress a Message in which he says:—"As a consequence of the ratification of the Treaty of Peace with Spain the United States will come into possession of the Philippines. The necessity of speedy communication *viâ* Hawaii and Guam is imperative. Such communications should be established in such a way as to be wholly under the control of the United States whether in time of peace or war." After mentioning the fact that at present the only cable communication with Manila is through foreign countries, and that there exists no means of communicating with Hawaii and Guam except by steamer, the Message continues:—"The present conditions should not be allowed to continue a moment longer than is absolutely necessary." President McKinley mentions as a remedy for this state of things the construction and maintenance of a cable either by the Government or by a private United States corporation under such safeguards as Congress shall impose. The Message does not contain any recommendation of either course. It says:—"At least two years must elapse after the giving of an order before the entire system can be laid. Further soundings for a route west of Hawaii are required. Under circumstances of such paramount necessity measures will be taken in the present Congress to provide the means for the establishment of the proposed system." The Message commends the whole subject to the careful consideration of Congress, and to such prompt action as may seem advisable.

CONTRACTS OPEN AND CLOSED.

OPEN.

Belfast.—February 23rd. The Electric Committee wants tenders for water-tube boiler, two steam dynamos, and switchboard. See our "Official Notices" February 3rd.

Bury.—February 21st. The Sewage Committee wants tenders for three electric motors for their sewage disposal works. See our "Official Notices."

Bury.—February 22nd. The Sewage Committee wants tenders for the wiring of the sewage works for electric lighting and power. See our "Official Notices."

Canterbury.—March 14th. Tenders are wanted for boiler house plant, engine house plant, extensions of switchboard and mains. See our "Official Notices" this week.

Christiania.—February 26th. The Secretary of State for Foreign Affairs has received a despatch from Her Majesty's Consul-General at Christiania, stating that tenders are invited by the Norwegian State Telegraph Administration for the delivery of about 140,400 porcelain telegraph and telephone insulators. Tenders must be received at Christiania by 12 o'clock noon on February 26th, 1899. A copy of the specification, conditions, &c., may be examined on personal application at the Commercial Department of the Foreign Office any day, between the hours of 11 a.m. and 5 p.m.

Dublin.—February 24th. The Corporation wants tenders for the supply of about 8,000 200-volt lamps. See our "Official Notices" this week.

Dundee.—March 15th. The Gas Commissioners are inviting tenders for four Lancashire boilers, two 450-H.P. steam engines and dynamos, and one 700-H.P. steam engine and dynamo. Particulars from the electrical engineer, Mr. W. H. Tittensor. See our "Official Notices" this week.

Edinburgh.—February 20th. The Council wants tenders for overhead travelling crane and storage batteries. See our "Official Notices" February 3rd.

Edinburgh.—February 27th. The Council want tenders for steam, exhaust, feed, and drain pipes, feed pumps and tanks. See our "Official Notices" February 10th.

Edinburgh.—March 6th. Tenders are wanted for condensing plant with water cooling tower, feed water tanks and filters for the electricity works. The Corporation also wants tenders for electric lighting installation at Tollcross tramway power station. See our "Official Notices" for particulars of both contracts.

France.—February 28th. Tenders are being invited by the French post and telegraph authorities in Paris for the supply of 10,000 metres of iron pipes, 65 mm. diameter, for pneumatic pipe lines. Tenders to be sent to Le Sous-Secretariat d'Etat des Postes et des Telegraphes, 103, Rue de Grenelle, Paris, whence particulars may be obtained.

Glasgow.—February 18th. The Kelvinside Electricity Committee, Limited, is inviting tenders until to-morrow for boilers and fittings, steam dynamos, and storage batteries. Specifications, &c., from Mr. J. M. M. Munro, consulting engineer, 136, Rothwell Street, Glasgow, on payment of one guinea.

Gloucester.—The City Council wants tenders for jet condensers, air pumps, cast-iron pipes, &c., for the electricity works. See our "Official Notices" February 3rd.

Greenock.—March 3rd. The Police Board wants tenders for the supply and erection of boiler-house plant, engine-house plant, and overhead travelling crane for their electric works (low tension). See our "Official Notices" this week.

Huddersfield.—February 27th. The Electricity Committee wants tenders for mechanical coking stokers, also for a complete switchboard. See our "Official Notices" this week.

Islington.—February 23rd. The Vestry invites tenders for the supply of electrical and engineers' stores for one year from March 25th. Particulars, &c., are obtainable at the Vestry Hall, Upper Street, N.

Italy.—February 25th. Tenders are being invited by the municipal authorities of San Severa (Province of Foggia), for the electric lighting of the town. Tenders are to be sent to Il Municipio di San Severa (Foggia), Italy, from whence particulars may be obtained.

Lewes.—March 24th. The Corporation is prepared to receive offers from those willing to establish an electricity supply undertaking. See our "Official Notices" this week.

London.—The Asylums Committee of the London County Council invite tenders for the supply of electric light sundries to the Claybury and Heath Lunatic Asylums for one year from April 1st. Particulars obtainable at the Committee's offices, 6, Waterloo Place, S.W.

Manchester.—February 20th. The Corporation wants tenders for the supply of sample electric tramcars. See our "Official Notices" February 10th.

Oystermouth.—February 27th. The District Council wants tenders for the supply of electricity within the area. See our "Official Notices" February 3rd.

Pernambuco.—March 18th. The Government of the State of Pernambuco invite tenders for the construction of an electric tramway to run between that city and Olinda, situated at about three miles distance. Tenders, duly sealed, must be addressed to the "Secretaria da Industria," Pernambuco, and should be received there not later than March 18th. Further particulars may be obtained on application at the Commercial Department of the Foreign Office any day between the hours of 11 a.m. and 6 p.m.

Redditch.—February 27th. The District Council wants tenders for the supply of about 100 alternating current meters. See our "Official Notices" this week.

Sheffield.—February 27th. Tenders are being invited by the Ecclesall Bierlow Union Guardians for an electric light plant for their workhouse, The Edge, Sheffield. Particulars from the architect, Mr. Webster, 19, St. James Street, Sheffield.

Shoreditch.—February 28th. Tenders are invited by the Vestry for the supply for one year of electric cables, wiring and fittings, and engineers' stores. Forms on which to tender, and particulars, may be obtained from the Town Hall.

CLOSED.

Edinburgh.—The Electric Lighting Committee has accepted the estimates of Messrs. Redpath, Brown & Co., Edinburgh, and Arrol's Bridge Company, amounting to over £10,000, for the iron and steel work of the M'Donald Road electric light station.

Londonderry.—The following list of tenders sent in to the Corporation for the supply of arc lamp globes and carbons during year ending December 31st, 1899, is given in the *Contract Journal*. Mr. R. V. Macrory, city electrical engineer:—13 mm. carbons—Braulik & Co, 217, Upper Thames Street, E.C., 44s. 10d. per 1,000 feet (*accepted*), F. Henrion & Co., 75, Mark Lane, 34s. 11d.; English Electric Company, Brymbo, 39s. 6d.; Crompton & Co., Chelmsford, 40s.; Cox-Walker & Co., 40s.; General Electric Company, 41s.; Mavor & Co., 41s. 3d.; Brush Company, 41s. 4½d.; Buck & Co., 43s. 10d.; Pollard & Co, 44s. 3d.; Johnson & Phillips, 47s.; Siemens Bros., 55s.; Edison & Swan, 55s. 7½d. 16-inch opalescent globe—Irving, Rogers & Co, 4s. 8d. each (*accepted*); Edison & Swan, 5s. 3d.; Cox-Walker & Co., 6s.; A. and R. Cochran, 7s. 3d; Crompton, 7s. 6d; De Grelle Hondret, 8s. 6d.; Johnson & Phillips, 9s.; General Electric Company, 10s.

London.—Our contemporary, the *Contract Journal*, publishes the following list of tenders submitted for proposed

electric lighting works at the Northern Hospital, for the Metropolitan Asylums Board:—

SECTION 1.—SWITCHBOARDS, BOOSTER AND CONNECTIONS.

Cox-Walkers, Darlington	£463 10 0
General Electric Company, Limited	482 10 0
Veritys, Limited	634 10 6
Fuller-Wenström Electrical Manufacturing Company	690 15 0

Consulting engineer's estimate, £600.

SECTION 2.—BATTERY.

		A.
Hart Accumulator Company, Limited	£318 12 0	£15 4 0
Pritchetts & Gold	Informal.	—
D.P. Battery Company, Limited	370 10 0	55 10 0
Laing, Wharton & Down	380 0 0	16 10 0
Chloride Electric Storage Syndicate, Limited	410 0 0	25 0 0
Tudor Accumulator Company, Limited	414 0 0	28 0 0
Epstein Accumulator Company, Limited	420 18 0	37 10 0
T. Scott Anderson	450 0 0	55 0 0
Lithanode Electric Storage Company, Limited	458 9 0	21 0 0
Electric Power Storage Company, Limited	457 0 0	89 10 0

Consulting engineer's estimate, £400.
A. Annual maintenance for five years.

SECTION 3.—ELECTRICAL MAINS.

Callender's Cable and Construction Company, Limited	£773 1 6
British Insulated Wire Company, Limited	903 18 8
Johnson & Phillips	925 0 0
Western Electric Company	964 12 6
Laing, Wharton & Down	1,110 10 0
T. Scott Anderson	1,363 0 0

Consulting engineer's estimate, £1,100.

SECTION 4.—STEAM EXHAUST, FEED AND DRAIN PIPES.

R. W. Blackwell & Co.	£732 0 0
R. Taylor & Sons	840 0 0
Babcock & Wilcox, Limited	927 0 0
G. Wailes & Co.	945 0 0

Consulting engineer's estimate, £400.

SECTION 5.—WIRING AND FITTINGS.

R. Whipp & Co.	£2,750 0 0
G. Weston & Co.	2,875 0 0
Benham & Sons, Limited	2,902 11 8
T. Scott Anderson	2,935 0 0
Wells & Co.	3,081 0 0
G. F. Ratcliff & Co.	3,373 0 0
Laing, Wharton & Down	3,727 0 0
Drake & Gorham	3,900 0 0
H. G. Ellis & Co.	4,800 0 0

Consulting engineer's estimate, £2,850.

We are informed that Messrs. G. Weston & Co.'s estimate has been accepted by the Metropolitan Asylums Board.

FORTHCOMING EVENTS.

Saturday, February 18th.—At 3.15 p.m. Institution of Junior Engineers. Visit to the Ealing Electric Lighting and Destructor Works.

Monday, February 20th.—At 7 p.m. Telegraphists' School of Science, St. Martin's Town Hall, W.C. Presentation of medals and certificates by the Duke of Norfolk. Students' conversazione.

Wednesday, February 22nd.—At 8 p.m. Society of Arts. "Electric Traction and its Application to Railway Work," by Philip Dawson.

Thursday, February 23rd.—At 2 p.m. Institution of Electrical Engineers. Students' visit to the Incandescent Electric Lamp Company's Works, Brook Green, Hammersmith.

Friday, February 24th.—At 5 p.m. Physical Society. Agenda:—"The Joule-Thomson Thermal Effect," by E. F. J. Love, M.A.; "A Study of an Apparatus for the Determination of the Rate of Diffusion of Solids dissolved in Liquids," by Albert Griffiths, M.Sc.; "Note on the Source of Energy in Diffusive Convection," by Albert Griffiths, M.Sc.

LEGAL.

THE CITY CORPORATION *v.* CITY OF LONDON ELECTRIC LIGHTING COMPANY.

THE action of the Mayor, &c., of the City of London *v.* the City of London Electric Lighting Company, Limited, came on Wednesday last (February 15th) before Mr. Justice Kekewich in the Chancery Division, upon an adjourned summons. There were three agreements relating to the supply of electric light to the City of London, and made between the Brush Electrical Engineering Syndicate, Limited, and the Commissioners of Sewers; the Laing, Wharton and Down Construction Company, Limited, and the Commissioners of Sewers; and between the Brush Electrical Engineering Company, Limited, and the Commissioners of Sewers, and a number of questions were put to the Court, as follows:—

1. Whether or not the Corporation of London were entitled to have the public and private lighting of the City of London carried out by separate mains and separate generating plant both in the main thoroughfares and in the side streets, courts, lanes, &c.

2. Whether or not, for the purpose of public lighting, the Corporation are entitled to a continuous current of electricity both in the main thoroughfares and in the side streets, &c.

3. Whether under Clause 13 of the contracts the engineer of the Corporation was entitled at any time to determine the position of all or any of the electric lamps, whether in the main thoroughfares or in the side streets, courts, &c., and whether or not the contractors were forthwith bound to fix lamps in the determined position.

4. Whether or not, under Clause 15 of the contracts, the Corporation were entitled, when once glow lamps had been fixed in the streets, to order all the glow lamps to be replaced by arc lamps, and whether or not the contractors were bound to carry out such alteration.

5. Whether or not, under Clauses 15 and 16 of the contracts, the only cost which the Corporation can be called upon to pay in respect of replacing the glow lamps by arc lamps was the cost of removing the old lamps, and fixing the new lamps, and whether or not, in the event of the glow lamps being changed for arc lamps the contractors were bound, at their own cost, to supply the necessary plant, machinery, and arc lamps for lighting the side streets, &c., by arc lamps.

6. Whether or not, provided the total consumption of electricity in the side streets, &c., when lighted by arc lamps, in pursuance of alterations made under Clause 15 of the agreements, does not exceed the total consumption of electricity provided for in the contracts when the side streets, &c., were lighted by glow lamps, the contractors were entitled to any further payment for lighting and maintenance by arc lamps than they would be for lighting and maintenance by glow lamps.

7. Whether or not, under the terms of the contracts, the Corporation are bound to light the side streets, &c., with electricity, and whether or not the engineer to the Corporation is not entitled under Clause 34 of the contracts to certify that the public lighting has been completed as soon as the electric lighting of the main thoroughfare has been completed.

8. Whether or not on account of the lamps ordered to be erected by the Corporation not being either 100-watt lamps or 200-watt lamps, as set out in Clause 8 of the contracts, but 250-watt lamp or lamps of any other specified power, the price to be paid by the Corporation is proportional to the watts used upon the scale set out in Clause 8 of the contracts.

Mr. WARRINGTON, Q.C. (who appeared with Mr. Fletcher Moulton, Q.C., and Mr. A. J. Walter) for the plaintiffs, said that the questions his Lordship had to determine were questions of construction arising on three separate contracts, which were *verbatim* the same, and made between the Commissioners of Sewers and the Electric Lighting Companies mentioned. The benefit of those contracts, and the burden of them had, with the consent of the Corporation, become vested in the defendants, the City of London Electric Lighting Company, Limited, and on the other hand, the interest of the Commissioners of Sewers under those contracts had become vested in the Corporation of the City of London, and therefore the parties which his Lordship had now before him was the Corporation of the City of London on the one hand, and the City of London Electric Lighting Company on the other. The first question, and the most important question which his Lordship had to determine, was whether or not, according to the true construction of the contracts the Corporation were entitled to require that the public lighting of the City, both in the main thoroughfares and in what were called the side streets, lanes, and courts, was to be kept as a separate and distinct undertaking, with separate generating plant and separate mains from what was called in the contracts the private lighting of the City of London. That was the first question which his Lordship had to determine, and that was of great importance both to the Corporation and to the contractors, mainly for the reason that the contracts provided for the purchase by the Corporation of the undertakings, and the terms of purchase in the one case were different from the terms of purchase in the other, and, therefore, if the contractors were at liberty to mix the two systems up together and to carry them on conjointly there would be a great difficulty of exercising that option of purchase. The second question his Lordship had to determine was also one of considerable importance. His Lordship would see that the contracts provided for the lighting of the main thoroughfares by arc lamps, and the lighting of the side streets by glow or incandescent lamps. The Corporation had certain powers of alteration under the contracts, and the main question his Lordship would have to determine on this part of the case was whether or not under those powers of alteration the Corporation could require the contractors to substitute arc lamps either the same or, as was contemplated, of lesser calibre than those provided for by the contract for the glow lamps in the side streets, and if they were entitled to direct that alteration, then on what terms as to payment, costs, and expenses they were entitled to require that change. Then another extremely important question which arose out of the second issue was as to the rate at which the Corporation were to pay for the light supplied to the side streets, if it was supplied into smaller arc lamps than those provided for by the contract. It was proposed, if the Corporation could do so, that in lieu of glow lamps there should be substituted in the side streets arc lamps of 5 amperes. The arc lamps in the main streets were of 10 amperes. The question to be determined was at what rate, according to the true construction of the agreement, the 5-ampere lamps were to be paid for, they being of different electrical energy from those mentioned in the contract. Those were the principal questions his Lordship would have to determine.

Mr. Justice KEKEWICH: They are quite distinct, apparently.

Mr. WARRINGTON said that they were. There were two other questions which were comparatively of less importance, but they were of importance. The first was as to whether the Corporation were entitled to require the contractors to continue a continuous current which had been supplied since the contracts had been entered

into, or whether the contractors were entitled under the contract to substitute for the continuous current, which the Corporation had hitherto enjoyed, an alternating current, the difference being that the continuous current gave better results for street lighting, where it was desired to get as much light below the lamp as possible, than the alternating current did. The learned counsel stated that the other matters his Lordship had to determine were of minor importance, and then read one of the contracts in question, and commented upon the different clauses bearing on the points in dispute in great detail. His submission was that the form of the agreement on the first question his Lordship had to decide showed that the parties were dealing both with a public system and a private system, and that the whole construction of the agreement was in accordance with the view of the Corporation and inconsistent with any other view.

Mr. Cripps, Q.C, M.P. (with him Mr. Hamilton) having been heard on this point on behalf of the defendants, his Lordship answered the first question in the negative.

Mr. Justice Kekewich was then addressed by the learned counsel on the other questions, and answered question No. 2 in the negative, and questions 3, 4 and 5 in the affirmative; question 6 was struck out; No. 7 was answered as to the first part in the affirmative, and as to the last part in the negative. No. 8 was answered in the negative. Each party was ordered to pay its own costs.

Reed *v.* Dunn & Watson and Belshaw.

In the Westminster County Court on Wednesday last week, this action came before his Honour, Judge Lumley Smith, Q.C., and was a claim for damages for trespass and conversion of electric fittings. Mr. Turner was counsel for the plaintiffs, Mr. Pesse for Dunn and Watson, and Mr. Wheatley for the other defendant.

Mr. Turner said the circumstances of the case were somewhat peculiar. Plaintiff had offices in Bedford Row, and resided at 35, Lincoln's Inn Fields. He occupied the floor, and Messrs. Andrews laid on the electric light for him some years ago, but about two years ago he had it disconnected from the main. The leads remained. Messrs. Dunn & Watson, architects, became tenants of the second floor last September, and in the following month plaintiff discovered, when he touched a switch, that his light was on. He had a gentleman in from Messrs. Siemens, and found the second floor installation was connected with his private leads. On October 12th he heard tapping in one of his rooms, and found a workman of Mr. Belshaw's, electrician, disconnecting his fittings from his leads. Belshaw had done all the electrical work for Dunn & Watson. There were communications between the three firms, and the two defendant firms threw the blame of the whole affair on each other. There was a talk about purchase of plaintiff's leads and compensation, but all the arrangements fell through, and the action was brought. The cost at the laying on to plaintiff was £15.

After hearing the case at considerable length, the Judge said this was an action that ought never to have been brought. It was an action for trespassing on plaintiff's electric light fittings and on his premises. He had some fittings that were of no use to him, and someone in error connected themselves with them. On the whole there was technical damage. He treated the matter as a whole, and gave plaintiff a verdict against the three defendants for the sum of 10s. The costs were nominal, and plaintiff would have costs against Belshaw, and Dunn & Watson would have costs against the plaintiff.

NOTES.

Foreign Competition.—Municipal contracts are almost invariably saddled with particular clauses relating to a minimum wage. Yet we read in the daily press of certain Belgian cement being imported, on which the London County Council merely demanded a quality test. It is pertinently asked if the same conditions as to wages were demanded from the Belgian manufacturers which the County Council so loves to cram down the throats of English contractors. We do not object to this foreign competition, but we do object to see English manufacturers handicapped by what is virtually a bounty to foreign competitors.

Municipal Trading.—Mr. Sydney Morse, chairman of the Electrical and Allied Trades Section of the London Chamber of Commerce, writes to the daily press, drawing attention to the serious effect that municipal trading may have upon private traders if the 70 corporations who are now seeking powers "to manufacture and sell dynamos and other electrical fittings," are successful. The real question is how far are we to allow the municipalising tendency to proceed? Mr. Morse suggests that if municipalities are victorious in this instance there is no telling to what lengths and breadths they may attempt to carry the principle, with an increasingly disastrous effect upon the private traders' interests. Therefore it is necessary to move in the matter immediately before it becomes too late.

Electricity at the General Post Office.—On Wednesday last week Mr. W. H. Preece, C.B., F.R.S., read a paper before the Liverpool Engineering Society on the above subject. Mr. Preece said that he had spent 47 years in the telegraphic service, 17 years with private companies, and the remainder with the Government. With regard to the telephone system, he said it had been stated that patent rights had been offered to the Post Office and declined, but that was not true. The patents really were never offered to the Post Office. Every improvement that had since been adopted in America and elsewhere in the working of telephones had emanated from the British Post Office. The cable system under the management of the Post Office was next dealt with, and statistics were given in illustration of the enormous use to which electricity is put in connection with the postal service. Eleven different post offices were completely fitted with electric light installations, there were 65 motors at work, and the output was 4,322,600 units per annum. In the heating of the Post Office buildings waste steam was utilised.

Personal.—Mr. Killingworth Hedges, C.E., is at present in Southern India, where he has been asked to examine and report on the utilisation of the water-power in one of the ghâts, or valleys, where it is proposed to run a light railway, to be worked, if practicable, by electricity. Owing to the enormous expense of the Nilghiri rack rail mountain railway, which has not yet been opened for regular traffic since the disastrous landslip, the Government are not sanctioning the use of State capital for other similar schemes. Mr. Killingworth Hedges considers that it may be possible to run a narrow gauge light railway on the existing mountain roads, and if sufficient water-power is available to work the steep gradient portion of the line electrically, it is hoped that the initial capital expenditure can thus be reduced, and that there will be a considerable saving in working expenses.

Mr. C. M. Johnston, of Lancaster, was on Monday appointed by the Shrewsbury Town Council electrical engineer and manager of the Corporation electric works. The salary is £250 per annum, and 55 applications had been received for the post.

Municipal Enterprise.—Before the Lyncombe and Widcombe Institute last week Mr. Councillor G. Pearson, of Bristol, delivered an address on "Municipal Administration and Electrical Enterprise."

Obituary.—The death is announced of Mr. Joseph Ebbsmith, whose connection with tramway matters in this country some years ago will be remembered by many of our readers. He was very closely associated with the Birmingham Tramways Company, at one time acting as chairman, also with other tramway enterprises. At the time of his death, which occurred at Monté, Grand Canary, last week, Mr. Ebbsmith was in his 50th year.

We learn with deep regret of the death of Mr. Peter Christian Dresing, M.I.E.E., Engineer-in-Chief of the Great Northern Telegraph Company. Mr. Dresing was born and brought up at Aalborg, in Jutland, Denmark. In the year 1871 he came over to this country to enter the employ of the above-named company, a couple of years later taking part in the manufacture and laying of about 1,000 nautical miles of submarine cable. Ever since that time Mr. Dresing had been engaged upon the manufacture, laying, and repair of submarine telegraph cables in connection with the Great Northern Company's very extensive system. His very lengthy practical experience in cable work naturally resulted in the accumulation of a very valuable stock of useful knowledge on the subject. Mr. Dresing's death is the occasion for special regret for ourselves, as he was an occasional contributor of excellent articles to the Electrical Review, such contributions being always conspicuous for their sterling value to cable electricians. The late gentleman acted as local honorary secretary for Denmark of the Institution of Electrical Engineers, and seven years ago he was made a Knight of the Order of the Dannebrog. He has taken charge of the company's Copenhagen branch for some years past. Death overtook him at Copenhagen on 10th inst. at the early age of 47 years.

The General Electric Company's Dinner.—The ninth annual dinner and smoking concert of the staff of the General Electric Company, Limited, was held in the Empire room of the Trocadero Restaurant on Saturday, the 11th inst. A very large gathering of the staff and guests participated in the lavish hospitality of the company, the only drawback to the perfect enjoyment of the evening being the regrettable absence of the senior partner, Mr. Gustav Byng, who is on the Continent, slowly recovering from a somewhat lengthy illness. He did not, however, forget his assembled friends, for early in the evening a telegram of good wishes to everybody concerned arrived, to which a fitting reply was shortly afterwards returned. Mr. Max. Byng, chairman, proposed the health of the guests, and to this toast the Commander-in-Chief of the Electrical Volunteers (who did not seem quite certain whether he was a colonel, general, or K.C.B.), and Mr. Dane Sinclair replied. Mr. Hirst then fired off 10 maxims at the staff, some of which hit the mark and produced palpable consternation amongst the more youthful members; but it was evident that the veterans were too hardened for Mr. Hirst's projectiles to penetrate beneath the skin. Next year he must employ his heavy Guns. The Glasgow representative of the company gave us the astounding information that the vast strides which have been made in the progress of civilisation during the past decade or so has been entirely due to the company's operations abroad, beginning with the simple introduction of electric bells to the heathen, and ending in their complete submission to the seductive influences of the Athos, Pothos, and Aramis of Queen Victoria Street. The concert part of the programme clearly proved to the interested spectator that the staff, old and young, though stern and unrelenting in the pursuit of the philanthropic object of their lives, can yet unbend and soften under the combined influences of Wein, Weib, und Gesang, and that human nature is pretty much the same all the world over. We congratulate the company on a pronounced success, and offer our sincere wishes to Mr. Gustav Byng for his speedy return to the helm with renewed strength and vigour.

The Fall in the City Dividend.—The *City Press* has been questioning the secretary of the City of London Electric Lighting Company as to the reason for the fall in dividend from 10 per cent. to 6 per cent. Mr. Bull blames the new sliding scale of charges to consumers introduced last week. We must wait for the directors' report, which is expected daily, before we can quite appreciate this.

The Municipal Electrical Association.—Mr. E. Ruthven-Murray has been appointed honorary secretary of the above Association in place of Mr. A. B. Mountain, who has resigned. All communications on Association business should be addressed to Mr. Murray at 21, Acton Lane, Harlesden, N.W. We hope that the Association will go on to prosper in the hands of its new secretary.

Appointments.—Mr. E. H. Wright, of Bradford, has been appointed assistant electrical engineer at Oldham.

Mr D. Martin, A.M.I.E.E., electrician to Messrs. Wm. McGeoch & Co., has received the appointment of electrical engineer to Messrs. Mechan & Sons, of Cranstonhill Iron Works, Glasgow, and will commence his duties about March.

The Lancaster Electricity Committee has appointed Mr. W. A. Fraser, of the Edinburgh electricity works, to succeed Mr. Johnston (who goes to Shrewsbury) as Corporation electrical engineer.

Appointments Vacant.—The Manchester Technical Instruction Committee is wanting a superintending engineer to supervise the engineering equipment of the new Technical School now erecting. See "Official Notices."

The Telephone Question.—It was stated that in the House last night Mr. A. D. Provand was to ask Mr. Hanbury, Secretary of the Treasury, whether the Government intends to carry out the recommendations of the Select Committee on Telephones, which met last session. It is also stated that a Bill has been prepared, although it has not yet probably received the sanction of the Cabinet.

The Royal Society.—Among the papers down for reading yesterday afternoon were the following:—"On the Reflex Electrical Effects in Mixed Nerve and in the Anterior and Posterior Roots," by Miss Sowton. "On the Characteristic of Nerve," by Dr. A. D. Waller, F.R.S.

"Economical Supply of Power."—On Tuesday Mr. Alexander Siemens delivered an address before the Liverpool Chamber of Commerce on the above subject, his remarks making special reference to the South Lancashire electric power scheme.

Mr. Preece's Retirement.—Mr. W. H. Preece, C.B., F.R.S., having, on Wednesday, attained his 65th birthday, retired from the position of Engineer-in-Chief and Electrician to the Post Office, but it is believed that his services will be retained by the Postmaster-General as consulting engineer.

New Engineer-in-Chief to the Post Office.—We have much pleasure in announcing that Mr. J. Hookey, Assistant Engineer-in-Chief, has been appointed to the position of Engineer-in-Chief to the General Post Office.

Motor Cars at this Year's B.A. Meeting.—The Mayor of Dover, Sir William H. Crundall, is organising, in connection with the meeting of the British Association to be held in Dover between September 13th and 20th, an important exhibition and parade of motor cars. Owing to the favourable position of the town, and the fact that the French Association are meeting by arrangement at Boulogne at the same time, it is anticipated that Continental makers will be very largely represented, and it is hoped that English makers will not be behindhand. Prizes of considerable monetary value will be offered in connection with the exhibition.

Electric Lighting of St. Paul's Cathedral.—Our readers will remember that some years ago various experiments were made with a view to lighting St. Paul's by electricity, arcs and incandescents being tried. Nothing, however, came of it at the time. It seems that subsequently further experiments have been carried out with the result that it is now announced that the authorities are arranging to spend £5,000 upon the installation.

Electric Broughams.—It is announced in a daily paper that in about a month's time some 40 electric broughams will be placed on the London streets. They will weigh only 16 cwt. each, instead of 2 tons, the weight of an electric cab. We are tempted to wonder whether this announcement will rank for veracity with that memorable promise of "100 electrical omnibuses shortly."

Tramways, Telephones and Coolies.—Toward the end of January the Colombo Post Office authorities determined to try an overhead metallic telephone circuit, as the electric tramways are responsible for disturbances in the present earth circuit system. The Post Office employés proceeded to affix the telephone wires to the tramway standards, with the result that in spite of warnings to exercise great care the wire came into contact with the tramway conductor, inflicting a serious shock upon three men. It is a pity some of those Rickshaw coolies, who make a point of placing boulders upon the tramway track at dark places, and hurling stones at the cars, cannot be cured of their dislike for up-to-date transport in a similar way.

Smoke Prevention.—The Public Control Committee of the London County Council state that the chimneys at Woolwich Arsenal are great offenders, and produce considerable nuisance, and they consider it wrong that a Government department should go free while private individuals are made to find a remedy. The Committee express themselves pleased at the magnitude of recently imposed fines, as though there could be only one side of the smoke question. But, after all, the London County Council concerns itself rather with piling up the rates and helping the foreigner and fomenting strikes, and cares but little for the prosperity of traders.

The Smoke Nuisance.—With a fine amounting to over £100 at one prosecution on several summonses at the rate of £10 per summons plus 2s. costs, the price of electricity as delivered by the City of London Electric Lighting Company cannot well be reduced. We think the prosecution of this company, who were fined a series of £5 some little time ago, has now amounted to persecution. The defendants urged that there had not been time to alter their boilers so as to prevent smoke. We believe the City of London Company's boilers are of the water-tube type, and such boilers must inevitably make smoke unless they are provided with a different form of furnace from that ordinarily employed. The so-called Scotch furnace is one such modification, but it is a system which cannot be applied in a day. There are certain mechanical stokers which will serve the same end, but to apply these is also not a matter of a day or a month, and if a company is able to show that the necessary steps are being taken, we do not think that fines should be continuously imposed. Black smoke is not a pleasant thing, but its one evil beyond the outpouring of a perfectly smokeless chimney is comprised in the one word, soot. A smoky chimney is otherwise no more unhealthy than one which does not smoke at all. It is not as though smoke were indicative of other evils. It is time, however, that boiler makers devoted more attention to the forms of their furnaces and ceased the futile task of sending out boilers into the world entirely unsuited for bituminous fuels.

The Coal Smoke Abatement Society has now a membership of nearly 200, and it is stated to intend taking in hand an active agitation against the smoke nuisance immediately.

Lectures.—Mr. A. A. Campbell Swinton will give a lecture on "Electric Discharges in Vacuo and the Röntgen Rays," at the Glasgow Philosophical Society, on March 1st.

On 1st inst., under the auspices of the Marylebone Presbyterian Church Literary Society, Mr. F. Tandy, A.I.E.E, lectured upon "X-ray Photography." Dr. J. H. Gladstone, F.R.S., who presided, paid a graceful compliment to the lecturer for his admirable treatment of a subject about which so little is as yet known. The induction coil was loaned from Mr. W. H. Preece, C.B. Messrs. R. and G. Taylor acted as demonstrators.

On 10th inst. Mr. Lester Taylor read a paper on "Fire Office Rules for Electrical Installations" before the members of the Insurance Institute of Yorkshire, at Leeds.

Before the Yorkshire College Engineering Society on 13th inst., Mr. E. Talbot, electrical engineer to the Leeds Corporation, read a paper on the "Leeds City Electrical Tramways."

On 9th inst. a course of lectures on "Applied Electricity" was commenced by Prof. Barrett and Mr. W. Brown, B.S.C., at the Royal College of Science, Dublin.

As announced in our "Official Notices," Prof. J. Perry will on Monday lecture to working men on "Practical Methods of Calculation," at the Museum of Practical Geology, Jermyn Street.

Presentation.—Last week the Wallasey branch of the National Electric Free Wiring Company presented their late superintendent with a silver-mounted liqueur service on the occasion of his leaving to take up an appointment with the British Insulated Wire Company.

Will.—The will of the late Dr. Eugen Obach shows the value of the estate as £12,193. Among his various bequests we observe that his scientific technical library goes to the Siemens Engineering Society at Woolwich, upon the condition that it is continued as the Obach library, a catalogue being placed in the hands of all the members. His special library on India-rubber and gutta-percha, together with the samples of plants, patterns, &c., passes on to the Botanical Museum at Berlin.

NEW COMPANIES REGISTERED.

Garston and District Electric Supply Company, Limited (60,658).—This company was registered on February 11th, with a capital of £25,000 in £1 shares, to carry on the business of electricians, electrical and mechanical engineers, suppliers of electricity and electrical apparatus manufacturers. The first subscribers are:—George H. Nisbett, Ashfield, Huyton, Lancashire, engineer, 5,000 shares; Alfred Tracey, 9, Vicarage Place, Prescot, Lancashire, one share; Sidney P. Doudney, Inglewood, Prescot, engineer, one share; Frederick W. Le Lall, 21, Station Road, Prescot, Lancashire, engineer, one share; Edward Tracey, Thornhill, Warrington Road, Prescot, Lancashire, secretary, one share; Darioni Bates, Stanley Crescent, Prescot, Lancashire, gentleman, one share; Jacob Atherton, Singleton, Huyton, Lancashire, merchant, 5,000 shares. The number of directors is not to be less than two nor more than five. The first are Jacob Atherton and George H. Nisbett; qualification, £250; remuneration as fixed by the company.

Mica Boiler Covering Company (60,565).—This company was registered on February 6th, with a capital of £75,000 in £1 shares (37,500 preference), to adopt agreements with the Mica Boiler Covering Company, Limited, and with Henry C. Michell, and to manufacture, sell, and deal in mica, mica waste, flake mica, Michell's mica boiler covering, wood jacketing, felt or matted cloths, silicate cotton, asbestos, boilers, steam engines, steam pipes, electrical insulating and other material. The first subscribers are:—Paul A. Makins, 1, Lowther Gardens, Kensington, S.W., manufacturer, 500 shares; John Graham, 24, Coleman Street, E.C., solicitor, 500 shares; C. R. Tritton, 36, Queen's Gate, S.W., gentleman, 500 shares; Leslie S. Robertson, 28, Victoria Street, S.W., engineer, 500 shares; W. M. Mordey, 83, Victoria Street, S.W., electrical engineer, 500 shares; H. C. Michell, manufacturer, and John Doig, 24, Old Broad Street, E.C., one share each. The number of directors is not to be less than three nor more than seven; the first are Paul A. Makins, Leslie S. Robertson, W. M. Mordey, Charles R. Tritton, Nicol Kingsmill, and David S. Michell; qualification, £500; remuneration, £50 each per annum and £100 for the chairman. Registered office, 24, Old Broad Street, E.C.

Selsey Gas and Lighting Company, Limited (60,574). This company was registered on February 7th, with a capital of £7,000 in £1 shares, to supply gas, electricity and other light and power in the parish of Selsey, Sussex, and its neighbourhood. The first subscribers (each with one share) are:—Henry F. Arms, 15, Mattock Lane, Ealing, W., gentleman; Henry Hughes, 23, Martin's Lane, E.C., solicitor; Newton Clayton, Park House, Selsey, gentleman; Edwin R. Painter, 156, Larkhall Lane, Clapham, S.W., accountant; Joseph A. Longest, 17, Upham Park Road, Chiswick, W., clerk; Robert S. Mayne, St. Stephen's Chambers, Telegraph Street, E.C., accountant; Alexander F. Pain, 49, Arthur Road, Holloway, engineer. Table "A" mainly applies. Registered office, 20, St. Stephen's Chambers, Telegraph Street, London, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

London Electric Omnibus Company, Limited (47,990).—This company's annual return was filed on February 9th. The capital is £250,000 in £1 shares (80,000 deferred). 22,059 ordinary and 79,200 deferred shares have been taken up, and 1,000 ordinary and 79,200 deferred shares are considered as paid. The full amount has been called on the others, and £34,556 12s. 6d. has been paid. £14,176 18s. has been paid on 27,348 forfeited shares, and 1,600 ordinary and 800 deferred shares have been cancelled. £697 5s. 6d. is in arrears.

Urban Electric Supply Company, Limited (57,986).—This company's statutory return was filed on November 15th, when seven shares were taken up out of a capital of £100,000 in £5 shares. No calls have been made.

London Electrical Cab Company, Limited (50,104).—This company's annual return was filed on January 30th, when 101,187 shares were taken up out of a capital of £150,000 in £1 shares; 24,811 are considered as paid, and £75,894 15s. has been paid on the others; £542 is in arrears, and £60 15s. has been received in connection with the forfeiture of 144 shares.

Salisbury Electric Light and Supply Company, Limited (41,414).—This company's annual return was filed on January 5th, when 3,807 shares were taken up out of a capital of £20,000 in £1 shares; 2,500 shares are considered as paid, and £1,051 5s. has been received, leaving £255 15s. unpaid.

CITY NOTES.

Liverpool Overhead Railway Company.

The twenty-first half-yearly general meeting of the shareholders in the Liverpool Overhead Railway Company was held at Liverpool on Tuesday, 14th inst., Sir Wm. B. Forwood, chairman of the board, presiding.

The Chairman, in moving the adoption of the report, said the directors were very gratified to be able to come before the shareholders with such a very satisfactory statement of accounts. The gross profits of the half-year had been £40,655, against £37,558 in the corresponding half of the previous year; an increase of £3,097. The expenditure was £24,717, against £24,240; but it was only fair to point out that in the corresponding half of last year they had a charge of £1,500 for the tramways. Therefore, properly speaking, the expenses had gone up £1,977, for which they had earned increased receipts of £3,097. The net revenue was £15,938; they had brought forward a balance of £3,868 from the previous half-year; and they had credit during the half-year of £184 of interest; making altogether £19,986 of net revenue with which they had to deal. The debenture interest was £3,400, leaving £16,856. The preference interest would require £3,000, and the directors now recommended a dividend for the past half-year at the rate of 4 per cent. per annum, as against 3½ per cent. in the corresponding half of last year, leaving a balance of £4,585 to carry forward. Perhaps some shareholders might suggest that there was room in this increased balance to pay a little more dividend; but he was quite sure the course they recommended was a safe and prudent one. It was well known to them all that they had at present a formidable competition at the Dingle station. The directors believed the growth of traffic along the dock line would fully compensate them for any loss of traffic they might sustain there, and he thought they saw their loss to-day at its worst, for not only had the electric tramways all the attractiveness of novelty, but they had practically obstructed the approach to the Dingle station. He did not think the Corporation could avoid that, but for the past six weeks it had been almost impossible for either passenger or vehicle traffic to get near Dingle Station. They would continue to give every facility to travellers to and from the Dingle, where the growth of traffic had been very remarkable. It was an extraordinary thing that the more facilities were given to traffic the more it would increase. He believed the increased facilities given by the Corporation would give such a fashion to travel by public conveyances that it would lead to increased traffic by the overhead railway. Referring to the growth of the traffic on the line, he said it had increased in the short space of six years from 3½ millions to 10 millions per annum, which he thought was abundant to justify him in expressing the hope that any loss of traffic sustained at the Dingle, they would more than make up in the general growth of traffic along the dock line of railway. The expenditure in connection with the lighting of the line and carriages had rather gone up. They had spent £1,200 during the half-year in new storage batteries, the old ones being replaced at a total cost of £2,500. These batteries had a very short life, only three or four years. They had now at the credit of the renewal fund £12,400. Hitherto they had paid for renewals out of revenue, and he hoped they might be able to keep the fund intact for a little longer. They were gradually accumulating a contingent fund, which now amounted to £700. They had that day completed an arrangement with the Dock Board, by which the Stanley Dock bridge would be kept closed until 12 o'clock at night, which would enable them to have a service of trains to the North End until half-past eleven at night, corresponding with the present service to the Dingle. He next alluded to the arrangement with the Waterloo and Seaforth and Great Crosby District Councils for the working of the tramway which these bodies had obtained a provisional order to construct, extending to 2½ miles from the Seaforth station to Cook's Road, Crosby. The local authorities would lay the load and rails for the tramways, and their company were to provide the electrical equipment of cars and trolley lines, and to maintain the rails. They had agreed to pay the District Councils 8½ per cent. per annum interest on the cost incurred in laying the rails for 20 years. That covered their interest and sinking fund on the estimated cost, and at the end of the 20 years, when the sinking fund was wiped off, the annual payment would be reduced to 4 per cent. for the remaining six years of the lease. The total expenditure their company would have to incur in providing the necessary equipment was £25,813. He thought it would be obvious to all who were acquainted with the north end that this was a desirable arrangement to have made.

Mr. R. Hobson seconded the motion, which was carried.

Sir William Forward and Mr. H. Brocklebank were re-elected directors.

At the close of the general meeting an extraordinary meeting was held, at which a motion was passed sanctioning the promotion of a Bill in Parliament to empower the company to lease and work the new tramways in the Waterloo and Crosby districts.

The Chairman explained that it would not be necessary at present to raise any new capital to provide the £25,800 proposed to be expended in the new undertaking. They had £12,000 in one fund, and before the line was completed they hoped to have sufficient money in hand without issuing any capital. The 8½ per cent. interest would be paid on a capital expenditure by districts of £16,000. If it was deemed advisable from the point of economy to erect a new generating station they would do so.

The Northampton Electric Light and Power Company, Limited.

The tenth annual report, to be presented at the annual meeting of the shareholders on February 23rd, 1899, reads as follows:—The extension of the company's operations during the past year has been considerable. The demand for current for lighting and motive power, translated into lamps of 8 C.P., has grown from 11,084 to 13,061 lamps fixed. Large additions have been made in houses already supplied, a sure sign of appreciation, but the company's mains are only now reaching private residences in any large number, and it is in this class of house that the largest profit to the company is to be looked for, combined with the most economical use by the consumer. The sliding scale, marked by "Wright's Indicator," encourages the consumer to employ the light in bedrooms, offices, passages, lavatories, &c., for the longer the supply is used the cheaper it becomes. The value of the electric current for motive power is becoming more generally recognised. There is also an increasing demand in churches and chapels. From the end of 1898 the price of current is reduced from 8d. and 4d. to 6½d. and 3½d. This change is made in view of the universal experience in other places, and is unquestionably the right policy, whatever may be the immediate effect on profit and loss. Places of worship are charged at 4½d., and motors at 3d. Discount at 5 per cent. is allowed in each case. A large increase has taken place in the provision of power. A new engine of 240 H.P. has been erected, with dynamo and accessories, making seven sets in all. This addition was made in view of the necessity for providing a sufficient reserve and for meeting contingencies, and is expected to serve for the whole of the current year. An abnormal expenditure has taken place during the past year, which accordingly has been weighted with an increase of interest on borrowed money, but it is hoped that benefit may accrue in the immediate future. The extension of mains is a necessary feature, very costly, and in no case producing at once an adequate return. Mains have been laid along the Billing Road, Cliftonville, Wellingborough Road, and Kettering Road, about 1¼ miles in all, making a total of about 3¾ miles. In pursuance of the same line of policy, it has been resolved, in answer to important demands, to continue the Kettering Road main to the further end of East Park Parade. An advance in the price of coal, the need for insuring under the Workmen's Compensation Act and an increase in rates have constituted, in the aggregate, a heavy tax. Against this may be set off the expected saving which should result from the introduction of apparatus of various kinds designed to effect economies in steam, coal, oil, &c. The directors have, after prolonged negotiations, succeeded in securing on fair terms a valuable addition to the freehold property of the company, consisting of a large double shop in Bridge Street together with a piece of land at the rear. The need of this land for extensions of engine and boiler houses at no distant date had been under the consideration of the board for a long time past. Hardly less important, in view of future developments, is the acquisition of an extensive property lying between the last-mentioned piece of land and St. John Street. The trustees of St. John's Hospital have, subject to the approval of the Charity Commissioners, consented to part with this in exchange for house and shop properties, which the company has arranged to purchase and to make over to the charity. Assuming this arrangement to be carried into effect, the company will be the possessors of an extensive but compact estate, with three important frontages. It is proposed to deal with the balance of £747 18s. 2d. shown by the net revenue account by paying a year's dividend on all shares for the year ending December 31st last, viz.:—On 6 per cent. preference shares, £232; on 5 per cent. preference shares, £145; and on ordinary shares at the rate of 2 per cent., £256 10s. 3d., carrying forward £114 7s. 11d. Further capital is now needed for paying off the temporary loan account, for completing the new purchase of land, and for extension of mains, It is proposed to issue 10,000 additional ordinary "B" shares which shall rank as part of the "second issue," and to offer these in the first place to existing shareholders, also to issue a limited number of debentures as occasion may arise. Messrs. H. Manfield and W. Tomes retire from the board in rotation and will be proposed for re-election.

Westminster Electric Supply Corporation.

The ordinary general meeting of the shareholders of the Westminster Electric Supply Corporation was held on Wednesday at the offices, Eccleston Place, S.W., Lord Suffield presiding.

In moving the adoption of the report the Chairman said:—I think the proprietors will find it satisfactory that we have been enabled to maintain our position during the past year. You will notice that the applications for supply still continue, and during the year the equivalent of nearly 50,000 lamps of 8 candle-power were connected, being an increase of 8,000 over the increase of the previous year. I have no doubt that that must be satisfactory to all the proprietors because it shows that we have held our own in a way that is, perhaps, astonishing. And this bears out my remark at the last general meeting that we have no reason to expect a decrease in the demand for supply, and I daresay, looking at the other side of the matter, the late rises in the price of coal combined with the coal strike had alone made a difference in one year's account of about £3,000, and, seeing that, I hope the proprietors will consider that the dividend we are paying is not unsatisfactory. That is to say, I do not know that the proprietors could have expected a large dividend, yet if it had not been for the difficulties such as I have just named, no doubt we should have been enabled to declare a large dividend. That was an accident we could not possibly have avoided. We, like other lighting companies, have found the absence of fogs during the winter season has affected the revenue to a considerable extent, while the reduction from 6d. to 4d. per unit after 4,000 units have been used for lighting in any one year, and to 3d. per unit for motor purposes has also affected the corporation in the same manner. There are one or two points on which, perhaps, the shareholders will require information, and we shall be happy to give it them.

Mr. Boulnois, M.P., seconded the motion for the adoption of the report.

Mr. Makins said all the expenses seemed to be higher than last

year, and he would also like to have the chairman's impression as regarded the future of the company.

Mr. Jefferies asked if any fresh capital was to be raised during the year.

Mr. Reed asked the chairman if he could give any information with regard to the acquisition of the new site.

The Chairman said he thought it was hardly necessary for him to answer the question of increased expenses because the report and accounts would show the vast increase in their business, and it was impossible, of course, to conduct an enormous business such as that without a very large expenditure in the way of staff, and, in fact, all round. The board of directors watched the expenditure most carefully and looked once a week into all the details of the business, and conducted the concern as economically as they possibly could. It was not, however, only a vast business now, but it was increasing weekly, and the expenses would also increase. With respect to the future of the company, he could honestly say that it was a very satisfactory one. They had an enormous number of lamps on circuit over last year and there was no reason to doubt the continuance of the success of the company. The company was very popular throughout the area, they had an extraordinary immunity from difficulties and few complaints, and most of the complaints they had were due to defects in the installation, and not due to the supply. He could, therefore, say honestly that the future of the company was extremely bright. They had no need of fresh capital yet, but they had powers to raise fresh capital for which they had no present necessity, beyond, of course, the £50,000 debentures. As to the question of site, he would ask Mr. Boulnois to reply to that.

Mr. Boulnois, M.P., said that he was one of three who were sent from the Westminster Company to represent the board on the Central Electric Supply Company. They had been quite unable to find a suitable site in Westminster for the extension of their premises which was absolutely necessary in consequence of their increased business. In consequence the Westminster Company joined with the St. James's Company in a joint station at St. John's Wood consisting of 2½ acres close by the Great Central Railway and the canal. Unfortunately for them the railway company cast longing eyes upon the land, and Parliament allowed them to take it. They had now chosen another site rather larger than the old site, and he thought they would ultimately acquire it, and that it would be a benefit both to them and the St. James's Company.

Mr. Makins said he hoped they would make a profit out of the railway company.

Mr. Boulnois, M.P., said that remained to be seen. They had to go to arbitration and they would make the most of it.

The report was then adopted, as was a resolution declaring a dividend at the rate of 14 per cent., making 12 per cent. for the year.

Waterloo and City Railway Company.

Mr. Wyndham Portal (chairman) presided on Thursday last week at Waterloo Station over the tenth half-yearly general meeting of the shareholders of the Waterloo and City Railway Company, and in moving the adoption of the report, said the shareholders would no doubt recollect that the last time he had the honour of meeting them he had to express his regret that their line was not opened, but that they expected it would be open every day. That day he met them and offered them sincere congratulations, both on his own behalf, and that of his colleagues, on the completion and opening of their railway. The value of the undertaking was not to be measured by its length of only one and a half miles, or its capital expenditure of about £600,000 when all the accounts were closed up, but rather by its importance to them as the owners and to the South-Western Railway Company as the workers of the railway, and also to the travelling public, to whom it was now and would prove of immense convenience. The experience of the past few months justified their expectations of the earning capabilities of the railway, as would be proved when they came to consider the figures he would give them. As regarded the difficulties in the working of the railway, to which allusion was made in the South-Western Railway report, they had every reason to believe that not only were they being overcome, but they had proved useful object-lessons to both companies, and would tend to their mutual advantage in the early future. As they knew, the line was open to traffic on August 8th last, a few days after their half-yearly meeting. They did their best to secure an earlier opening of the line, but found it inadvisable in view of the condition of some parts of the works and the objection of the South-Western Company to accept prior to the date the responsibility which would devolve upon them as workers of the line. The engineer's report would show them how they stood with the Central London Railway Company as regarded the City station subways and approaches, which were advancing towards completion, but somewhat too slowly for them. They had not failed in urging on the company to forward these works, and they would continue to give them their best attention. They had now an ordinary stock of £540,000, and debenture stock of £21,000, a total of £561,000 on December 31st. With regard to the debenture stock, he stated at the last meeting that it would be taken by the South-Western Railway. Their first issue bore interest at 3 per cent., and any further issue would only be for a small amount to complete their obligations on capital account. During the half-year they had expended on capital account £38,140, of which £26,100 was for construction of ways, &c., and £9,664 for electrical equipment. They had a balance on capital account of £11,543 with which they commenced the half-year. Their further expenditure on capital account was estimated at £52,000, and their available assets included the £11,543 which he had just mentioned. Assuming the estimate to be correct, and they believed it was, their total outlay of capital would not much, if at all, exceed the amount they anticipated, viz., £600,000, and, therefore, their present capital powers would cover all known liabilities, and would leave them an ample margin for any future requirements. The revenue account they submitted for the first time. The revenue receipts for the four months and the 24 days during which the line had been opened for traffic amounted, in the gross, to £11,887 10s. 6d., which included £217 for rents. They would be interested to know that 1,442,000 passengers travelled over the line, besides season ticket holders, and that involved the running of 40,360 train miles. Out of the revenue credit account £4,119 was retained by the London and South-Western Company against their working account, £309 went for general charges, £226 for rents, and the balance of £6,301 9s. was carried to net revenue account. After deducting the interest on the debenture stock, £8,390 remained available for dividend and that enabled them to declare a dividend at the rate of 3 per cent. per annum for the full half-year, which he hoped would be satisfactory to every shareholder. They had £15,000 at their bankers on current and deposit account. The London and South-Western Railway had given notice of a Bill for the ensuing session of Parliament, including powers over property of the company, and the Baker Street and Waterloo Railway Company were seeking powers in a Bill. Suitable arrangements with both, he hoped, would be made so that all the rights of the company should be protected. He believed that at every succeeding half-year the chairman would be able to give more and more favourable accounts of that important, although very small, railway. Up to the present they had every reason to be satisfied with the number of passengers using it, and he believed they would increase as time went on.

Lieut.-Colonel Campbell seconded the motion.

Mr. Beavis said that in Paris recently he saw a movable platform at work, and he suggested that probably something of the kind could be used at the City station by taking away half the incline.

The Chairman said the City end of the line did not belong to them. A moving platform was no novelty, and they would bear it in mind.

The report was then adopted, and the retiring directors re-elected.

The Kensington and Knightsbridge Electric Lighting Company, Limited.

The report of the directors to be presented at the twelfth ordinary general meeting to be held at No. 1, Great George Street, Westminster, on Wednesday, February 22nd, 1899, at 5 p.m., states that during the year the number of houses and shops connected with the system has increased from 1,620 on December 31st, 1897, to 1,851 on December 31st, 1898, while the number of lamps calculated on the usual basis of 8-candle-power has increased from 137,953 to 156,158. Additional capital required by the company during the year has been raised by the issue of £12,785 4 per cent. debenture stock, producing £13,807 16s., and by the issue of 1,187 second preference shares, producing £7,122. The directors have strengthened the renewal account by transferring to it £5,117 15s. 11d., making the total amount placed to that account £25,615 9s. 9d. After providing for the above amount, and paying the dividends on the 6 per cent. first preference shares to June 30th, 1898, on the 5 per cent. second preference shares to September 30th, 1898, and an interim dividend at the rate of 10 per cent. per annum on the ordinary shares for the first half of the year, the balance standing to the credit of the net revenue account for the year 1898 is £6,300 10s. 11d. Of the above sum £1,450 has been appropriated to the payment of the first preference dividend to the end of the year, and £400 has to be set aside to meet the portion of the dividend on the second preference shares accrued to the same date, leaving £4,450 10s. 11d., out of which it is proposed to pay a further dividend on the ordinary shares, at the rate of 10 per cent. per annum for the past half-year, making, with the interim dividend paid to June 30th, 10 per cent. for the year. This will leave a balance of £825 10s. 11d. Mr. G. H. Hopkinson having ceased to be a director, Sir Charles Grant, K.C.S.I., was appointed to fill the vacancy. It will be observed that after the general meeting there will be an extraordinary general meeting for the purpose of confirming the resolution passed on the 1st inst. relative to the Bill now being promoted by this company in conjunction with the Notting Hill Electric Lighting Company, the purport of which has been brought fully to the attention of the shareholders. In accordance with the articles of association, Sir Frederick J. Bramwell, Bart., F.R.S., and Mr. Granville R. Ryder, retire from the directorship, and being eligible, offer themselves for re-election.

Coventry Electric Tramways Company.

The annual meeting of this company was held in Bank Buildings, London, last week under the presidency of Captain Davy.

In moving the adoption of the report, the Chairman stated that the earnings for the year ending December 4th, 1898, amounted to £10,283, against £9,924 for the preceding year. On the old capital this would have sufficed to pay 21 per cent. on the ordinary shares, after paying 4 per cent. on the debentures and 6 per cent. on the preference shares. The new lines were rapidly nearing completion, and it was hoped that the full 10½ miles would be in operation shortly. The accounts submitted showed a sum of £2,673 available for dividend on the shares. Of the total capital of £112,000 only 9,600 shares of £10 each had been issued, and of these shares 8,000

were fully paid up, representing £80,000, and 1,600 were half paid up, representing £8,000, making a total of £88,000 paid up, leaving a balance of £8,000 to be paid on the completion of the works. The directors proposed to pay a dividend at the rate of 4 per cent. on the amounts paid up from dates of payment. This amounted to £2,182, and left a balance of £390 to be carried forward. The chairman concluded by saying that the directors had hitherto received no fees.

Baron RAM seconded the adoption of the report, which was carried.

The Scarborough Electric Supply Company, Limited.

THE directors' report states that during the past year 53 additional consumers, and the equivalent of 2,277 8-C.P. lamps, have been added to the company's system, making a total of 383 consumers and 22,344 lamps connected at the present time. During the past year electric energy to the amount of 220,009 Board of Trade units have been supplied to consumers, at a revenue, including meter rents, of £5,442 9s. 8½d., as against 214,044 units and £5,179 13s. 9d. revenue for 1897. The profit on the year's working is £2,331 16s., as against £2,044 13s. 0½d. for 1897, adding to this the balance of £188 12s 5½d. carried forward from 1897, and the sum of £278, being premiums on new shares issued, there is, after paying income-tax, £36 14s. 4d., bank interest £12 7s., and putting £416 12s. 7d. to depreciation, a sum of £2,332 14s. 6½d. available for distribution. The directors recommend that this should be applied in paying a dividend of 5½ per cent. (less income-tax), which will absorb £1,964 4s., leaving a balance of £368 10s. 6½d. to be carried forward. As will be observed, the depreciation fund now stands at £900.

South Staffordshire Tramways Company.

AN extraordinary general meeting was held on Wednesday last week at Cannon Street Hotel to consider the Bill in Parliament for conferring further powers upon the company with respect to the leasing and working of the tramways, &c. Mr. W. S. L. Schuster, who presided, stated that the Bill had been promoted by the British Electric Traction Company under an agreement dated June 11th, 1897, between this company and the Electric Construction Company. The solicitor called attention to the chief objects of the measure. Replying to discussion, the chairman stated that the present lease would expire in about 3½ years. The solicitor stated that if the Bill were approved by Parliament, the British Electric Traction Company would take over the lease of the property and would work it. If the measure were not passed, that company would have a claim upon this company for £16,000, which the chairman afterwards stated it would be difficult to raise, as all the capital powers of the company had been exhausted. Their company did not draft the Bill; under the agreement they had been bound to assist in its promotion, but the rights of voting of individual shareholders were not overridden. The British Electric Traction Company paid all the expenses of the measure. He then moved a resolution approving the Bill, which was seconded by Mr. Blundstone. An amendment was proposed, but the resolution was carried with three dissentients.

The India-Rubber, Gutta-Percha, and Telegraph Works Company, Limited.

THE directors' report for the year ending December 31st, 1898, to be presented at the general meeting at the Cannon Street Hotel on Thursday, 23rd inst., at 12 o'clock noon, reads as follows:—"The annexed accounts show, after provision for doubtful debts, a net profit for the past year of £62,222 2s. 2d. Adding £13,173 1s. 1d. brought forward, and deducting £12,500 interim dividend paid in July, there remains a disposable balance of £62,895 3s 3d. The directors recommend the distribution of a dividend of 15s. a share, free of income-tax, amounting to £37,500, making, with the interim dividend paid in July, a total payment of 10 per cent. for the year, and leaving £25,395 3s. 3d. to be carried forward. The general business has been more profitable during the past year than in 1897, the selling prices of goods having been advanced to meet the increase in the cost of the raw materials. The cable vessels have been moderately employed. The high efficiency of the Silvertown and Persan factories has been maintained by constant renewals, and by the replacing of plant and machinery where improved methods of manufacture have so required. The employment of electricity for the transmission of power is being extended at the works. The Melbourne agency has been reinstated in its original quarters, the burnt-out block having been reconstructed. Mr. Silver and Mr. Scott, the directors, retiring by rotation, offer themselves for re-election."

Blackpool and Fleetwood Tramroad Company.

THE annual meeting of this company was held at Manchester, on 10th inst., Mr. George Richardson (chairman) presiding.

In moving the adoption of the report, the CHAIRMAN expressed the pleasure with which the directors recommended the payment of a dividend of 8 per cent. At previous meetings they had not been able to report the earning of any money. Their present balance-sheet represented five and a half months' working. Their traffic up to date had been most satisfactory. It had exceeded expectations. They proposed to carry forward £3,296, part of which should be devoted to eliminating the amount for preliminary expenses from the balance-sheet. The general prospects of the undertaking were very good. They had made a mistake in not issuing sufficient capital at first. They did not expect to be required to find so much accommodation as now appeared to be necessary. The new capital, amounting to £30,000, would be applied solely to the actual business of the company, being used to buy additional rolling stock, increase their electric plant, provide waiting rooms, and in other ways meet the necessities of the public. If they did not do this they would be sure to have competition in some form or another. By next spring they hoped that everything would be in readiness to cope fully with the traffic.

Mr. R H. PRESTWICH seconded the adoption of the report.

In reply to questions the CHAIRMAN afterwards said they were not holding their own entirely in the winter, although the loss was not very large. The damage by the late gale only amounted to about £40.

The report was then adopted. Mr. R. B Barningham and Mr. R. S. Beddington were re-elected directors, and it was resolved that the directors receive £1,500 for past services, and henceforth £800 a year.

Yorkshire House-to-House Electricity Company.

AN extraordinary general meeting was held at the Great Northern Hotel, Leeds, last week, to confirm the resolution winding up the company. At a brief preliminary meeting it was resolved that a grant of £210 should be made to Mr. Robert Hammond, the consulting electrical engineer, as an acknowledgment of his services in connection with the formation of the company. Mr. Grosvenor Talbot was appointed liquidator of the company, and the other directors as an advisory committee. Mr. John Gordon was appointed auditor.

Stock Exchange Notices.—Applications have been made to the Stock Exchange Committee to appoint a special settling day in and to grant a quotation to: British Electric Traction Company, Limited—20,000 6 per cent. cumulative preference shares of £10 each; Doulton & Co., Limited—233,334 5 per cent. cumulative preference shares of £1 each; 233,334 first mortgage 4 per cent. irredeemable debenture stock; and to allow the following securities to be quoted in the Official List: British Insulated Wire Company, Limited—27,500 6 per cent. cumulative preference shares of £5 each, fully paid; Chelsea Electricity Supply Company, Limited—Further issue of £40,000 4½ per cent. debenture stock; House-to-House Electric Light Supply Company, Limited—Further issue of 4,000 ordinary shares of £5 each, fully paid, Nos. 15,762 to 19,761.

The Edison & Swan United Electric Light Company, Limited.—The directors have resolved that a payment on account of the dividend of the current year be made at the rate of 6 per cent. per annum, less income-tax, on the "A" shares of the company, in respect of the half-year ended December 31st, 1898. This will work out at 1s. 9$\frac{3}{5}$d. per share on the partly paid £5 shares £3 paid, and 2s. 9$\frac{3}{5}$d. per share on the fully paid £5 shares, less income-tax. The dividend warrants will be issued on 24th inst.

Central London Railway Company.—This company's meeting was held on Wednesday. A report will appear next week.

TRAFFIC RECEIPTS.

The Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending February 11th, 1899, were £143 18s. 8d.; aggregate to date, £881 14s. 2d.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending February 10th, 1899, were £2,356 13s. 9d.; corresponding period, 1898, £2,296 3s. 9d.; increase, £60 10s.

The City and South London Railway Company.—The receipts for the week ending February 12th, 1899, were £1,119; week ending February 13th, 1898, £1,058; increase, £61; total receipts for half-year, 1899, £7,807; corresponding period, 1898, £7,514; increase, £293. Miles open, 3½.

The Dover Corporation Electric Tramways.—The receipts for the week ending February 11th, 1899, were £141 2s. 1d.: week ending February 12th, 1898, £105 3s. 6d.; increase, £35 18s. 6d. Total receipts to date, 1899, £858 0s. 8d.; corresponding period, 1898, £643 2s. 2d.; increase, £209 18s. 6d. Miles of track open week ending February 11th, 1899, 3; week ending February 12th, 1898, 3. Car miles run week ending February 11th, 1899, 4,245; week ending February 12th, 1898, 2,581. Number of cars, week ending February 11th, 1899, 11; week ending February 12th, 1898, 7.

The Dublin United Tramways Company.—The receipts for the week ending Friday, February 10th, 1899, were as follows:—D. U. T. Co., horse cars, £1,813 4s. 8d.; ditto, electric cars, £860 3s. 5d.; D. S. D. Co., electric cars, £595 19s. 9d.; total, £3,269 7s. 10d.; corresponding week last year—D. U. T. Co., horse cars, £2,441 14s. 7d.; ditto, electric cars, £102 19s. 5d.; D. S. D. Co., electric cars, £363 2s. 3d.; total, £2,907 16s. 3d.; increase, £361 11s. 7d; aggregate to date, £18,691 1s. 7d.; ditto last year, £18,567 4s. 3d.; increase to date, £123 17s. 4d. Worked:—The mileage open is 18 miles electrically, 26 miles by horses, as against 11 miles electrically, and 31 miles by horses, for the corresponding period last year.

The Halifax Corporation Tramways. — The receipts for the week ending February 1st, 1899, were £306; total receipts to date, 1899, from June 29th, 1898, £8,190. Miles of track open, 3½. Car miles run, 5,347. Number of cars, 12. Week ending February 8th, 1899, £272; total receipts to date, 1899, from June 29th, 1898, £8,462 Miles of track open, 3½. Car miles run, 5,023. Number of cars, 12.

The Liverpool Overhead Railway Company.—The receipts for the week ending February 12th, 1899, amounted to £1,223; corresponding week last year £1,380; decrease, £157.

The South Staffordshire Tramways Company.—The receipts for week ending February 10th, 1899, were £553 16s. 7d.; aggregate receipts for six weeks, £3,449 10s. 9d.; week ending February 11th, 1898, £580 6s. 4d.; aggregate receipts for six weeks, £3,537 18s. 9d.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation, Feb. 8th.	Closing Quotation, Feb. 15th.	Business done during week ended Feb. 15th, 1899. Highest.	Lowest.
124,400£	African Direct Telegraph, 4 % Debs.	100	...	...	...	100 —104	100 —104	...	...
25,000	Amazon Telegraph, shares	10	...	...	...	3 — 4	3 — 4	...	...
125,000	Do. do. 5 % Debs. Red.	100	...	...	...	87 — 92	87 — 92	...	...
905,560£	Anglo-American Telegraph	Stock	£2 13s	3 %	£3 9s	68 — 70	67 — 69 xd	...	...
3,047,220£	Do. do. 6 % Pref.	Stock	£5 6s	6 %	6 %	120 —121	119 — 120xd	120½	119
3,047,220£	Do. do. Deferred...	Stock	...	...	18s. %	16¼— 17	15¼— 15⅝xd	16⅝	15½
130,000	Brazilian Submarine Telegraph	10	7 %	7 %	...	15⅝— 16¼	16 — 16½	16¼	15 11/16
75,000£	Do. do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	110 —114	110 —114	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	4 %	...	2⅝— 3¼	2⅝— 3¼	...	...
10,000,000$	Commercial Cable	$100	8 %	8 %	...	180 —190	180 —190	197	...
1,332,523£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	104 —106	105 —107	105⅞	105⅝
224,850	Consolidated Telephone Construction and Manufacturing	10/-	2 %	...	...	1/16— 3/16	1/16— 3/16	...	...
16,000	Cuba Telegraph	10	8 %	7 %	...	8¼— 9¼	9¼— 10½	9⅜	9⅛
6,000	Do. 10 % Pref.	10	10 %	10 %	...	17 — 18	17½— 18½	...	..
12,931	Direct Spanish Telegraph	5	4 %	4 %	...	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	...	10 — 11	10 — 11	...	...
30,000£	Do. do. 4½ % Debs., Nos. 1 to 6,000 ...	50	4½ %	4½ %	...	104 —107%	104 —107%	...	...
60,710£	Direct United States Cable	20	2½ %	...	...	12½— 13	12½— 12⅝	12⅝	12½
120,000	Direct West India Cable, 4½ % Reg. Deb. ...	100	...	...	...	102 —105	102 —105	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	...	...	...	177 —182	179 —184	182	178
1,295,000	Do. 3½ % Pref. Stock	100	...	...	...	103 —106	104 —107	106	105⅜
500,000	Do. Prov. Certs., all paid	...	...	...	...	103 —106	103 —106	...	...
89,900	Do. 5 % Debs., repayable August, 1899 ...	100	5 %	5 %	...	99 —102	99 —102	...	...
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	125 —129	126 —130	127	...
250,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	...	17⅜— 18¼	17⅜— 18¼	18¼	17⅜
16,200£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	5 %	...	99 —103	99 —103	...	...
64,400£	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	5 %	...	100 —103	100 —103	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	...	124 —128	125 —129	...	...
35,100£	Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	...	...	99 —103	99 —103	...	...
46,500£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	...	...	100 —103	100 —103	...	...
300,000£	Do. 4 % Mort. Debs., Nos. 1 to 3,000, red. 1909	100	4 %	...	...	102 —105	102 —105	...	...
200,000£	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	4 %	...	...	104 —107%	104 —107%	...	...
180,227	Globe Telegraph and Trust	10	4½ %	4½ %	...	12¾— 13¼	12¾— 13¼	13⅛	12⅝
180,042	Do. do. 6 % Pref.	10	6 %	6 %	...	16¾— 17¼	17 — 17⅛	17⅜	17¼
150,000	Great Northern Telegraph, of Copenhagen...	10	10 %	10 %	...	29 — 30	29½— 30½	29¾	...
150,000£	Do. do. do. do. 5 % Debs. ...	100	5 %	5 %	...	101 —104	101 —104	...	...
97,800	Halifax & Bermuda Cable, 4½ % 1st. Mt. Dbs., w'n. 1-1,200, rd.	100	...	...	...	99 —102	99 —102	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	...	58 — 61	58 — 61	...	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	6 %	...	109 —112	109 —112	...	...
484,597	National Telephone, 1 to 484,597	5	5½ %	6 %	6 %	5¾— 6	5⅞— 6⅛	6 1/16	5⅞
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	14 — 16	14 — 16	16	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	13 — 15	14 — 16	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	5⅝— 5⅞	5⅝— 5⅞	5⅜	5 11/16
1,329,471£	Do. 3½ % Deb. Stock Red.	Stock	3½ %	3½ %	3½ %	99 —101	100 —102	101	100
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	...	⅝— ¾	⅝— ¾	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	4 %	...	104 —107	105 —108	...	...
11,839	Reuter's	8	5 %	5 %	...	6½— 7½	6½— 7½	6⅔	...
3,381	Submarine Cables Trust	Cert.	...	...	...	136 —141	138 —143	140⅛	...
58,000	United River Plate Telephone	5	5 %	6 %	...	4¾— 5¼	4¾— 5¼	...	...
151,733£	Do. do. 5 % Debs.	Stock	...	...	...	104 —107	104 —107	...	...
200,000£	West African Telegraph, 5 % Debs.	100	5 %	5 %	...	100 —103	100 —103	...	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	½— 1	½— 1	...	...
150,000	Do. do. 4% Debs., 1—1,500 gua. by Braz. Sub. Tel.	100	...	...	...	103 —106	103 —106	...	...
64,269	Western and Brazilian Telegraph	15	2 %	3½ %	...	12¼— 12⅝	12½— 13	...	...
33,129	Do. do. do. 5 % Pref. Ord.	7½	5 %	5 %	...	8 — 8½	8¼— 8⅝	...	...
33,129	Do. do. do. Def. Ord.	7½	nil	½ %	...	4 — 4½	4 — 4½	...	...
889,521	Do. do. do. 4 % Deb. Stock Red. ...	Stock	...	...	...	105 —108	106 —109	108	105½
88,321	West India and Panama Telegraph	10	1 %	⅜ %	...	1½— 1⅝	1⅝— 1⅞	1⅝	...
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	6 %	...	10½— 10¾	10½— 10¾	10 5/16	...
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	6 %	...	8½— 9½	8½— 9½	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	...	104 —107	104 —107	...	...
158,100£	Western Union of U.S. Telegraph, 6 % Ster. Bonds ...	100	6 %	6 %	...	98 —103	98 —103	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electricity Supply	5	6 %	7 %	8 %	11 — 12	11 — 12	...	...
20,000	Do. do. do. 4½ % Cum. Pref.	5	...	...	...	6 — 6½	6 — 6½	...	...
34,000	*Chelsea Electricity Supply, Ord., ...	5	5 %	6 %	...	9 — 10	9 — 10	...	...
60,000	Do. do. do. % Deb. Stock Red....	Stock	4½ %	4½ %	...	114 —116	114 —116	...	...
50,000	City of London Electric Lighting, Ord. 40,001—90,000 ...	10	7 %	10 %	6 %	23 — 24	19 — 20	20½	19
10,000	Do. Ord. Nos. 90,001 to 100,000	10	...	...	...	22 — 24	18 — 20	19½	18⅜
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	15½— 16½	15½— 16½	...	...
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	...	125 —130	124 —129	125	...
30,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—30,000	10	nil	nil	...	12½— 13½	12 — 13	12⅜	12½
10,000	Do. do. do. Nos. 30,001 to 40,000 ...	10	...	...	...	12 — 13	12 — 13	...	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	...	14½— 15½	14½— 15½	14 15/16	14⅝
17,400	Edmundsons Elec. Corp., Ord. Shares 1—17,400	5	...	5 %	...	5 — 5½	5¼— 5⅜	5½	...
15,661	House-to-House Electric Light Supply, Ord., 101 to 15,761	5	...	4 %	...	9 — 10	9 — 10	...	...
12,000	Do. do. 7 % Cum. Pref. ...	5	7 %	7 %	...	9½— 10½	9½— 10½	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	3½— 4	3½— 4	...	...
48,050	Do. do. do. 6 % Pref.	5	...	...	...	6½— 7	6½— 7	6⅝	...
100,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	103 —105	104 —106	...	...
62,500	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	...	18½— 19½	17½— 18½	18½	...
22,500	Do. Nos. 62,501 to 85,000, £7 paid ...	10	...	...	...	12 — 13	14 — 15	...	...
220,000£	Do. 4½ % First Mortgage Debenture Stock	...	4½ %	4½ %	...	118 —121	118 —121	119½	...
6,452	Notting Hill Electric Lighting	10	4 %	6 %	...	17½— 18½	17½— 18½	...	...
31,980	St. James's and Pall Mall Electric Light, Ord.	5	10½ %	14½ %	14½ %	16½— 17½	16 — 17	16 1/16	16⅜
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 10	9 — 10 xd	9¾	...
65,000	South London Electricity Supply, Ord., £3 paid	5	...	...	...	3⅜— 3⅝	3¼— 3½	...	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000 ...	5	9 %	12 %	12 %	15½— 16½	15 — 16	15⅞	15¼

* Subject to Founder's Shares.
‡ Unless otherwise stated all shares are fully paid.
† Quotations on Liverpool Stock Exchange.
‖ Dividends paid in deferred share warrants, profits being used as capital.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation Feb. 8th.	Closing Quotation Feb. 15th.	Business done during week ended Feb. 15th, 1899. Highest.	Lowest.
60,000	Aluminium "A" shares, Nos. 1—60,000	1	...	...	...	3 — 3½	3 — 3½	3	...
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	94 —100	94 —100	...	...
30,000	British Electric Traction	10	...	...	...	17 — 18	17 — 18	...	...
10,000	Do. do. 6 % Cum. Pref. 30,001—40,000 (issued at £2 10s. prem. all pd.)	10	...	...	...	13½ — 14	13¼— 13⅜xd	...	...
100,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	120 —122	121 —123	122½	121¾
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	3	*nil*	*nil*	...	1⅞— 2⅛	1⅞— 2⅛	1⅞	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	*nil*	4 %	...	2⅛— 2⅜	2⅛— 2⅜	...	...
125,000*l*	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	111 —115	111 —115	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	101 —104	101 —104	101	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	...	...	...	10½— 11½	12½— 13½	13	11½
90,000	Do. do 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	110 —113	113 —116	...	...
35,250	Central London Railway, Ord. Shares	10	...	...	...	9¾— 10¼	9¾— 10¼	10⅛	9¹⁵⁄₁₆
178,303	Do. do. do. £8 paid	10	...	...	...	7¾— 8¼	7¾— 8¼	8¹⁄₁₆	...
61,033	Do. do. Pref. half-shares £3 paid ...	...	...	...	...	3½— 4	3½— 4	3¹¹⁄₁₆	...
71,447	Do. do. Def. do. £5 paid ...	...	...	...	...	4 — 4½	4 — 4½	4⁵⁄₁₆	...
630,000*l*	City and South London Railway	Stock	1⅛%	1⅞%	2⅛%	71 — 73	72 — 74 xd	73½	72
22,500	Do. do. Ord. shares, Nos. 1 to 22,500 £5 pd.	10	...	...	...	4⅜— 5⅛	4⅜— 5⅛	5⅛	5¹⁄₁₆
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	...	...	2¾— 3¼	2¾— 3¼	3⅛	...
82,850	Do. 5% 1st Mort. Reg. Debs., 1 to 743 of £100, and 901 to 1,070 of £50 Red.	...	...	...	...	98 — 101	98 —101	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	5½%	6 %	...	2¼— 3	2¼— 2¾	...	...
17,139	Do. do. do. "A" Shares, 01—017,139	5	5½%	6 %	...	4 — 5	4 — 5	...	...
194,023	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	97 — 99	97 — 99	98½	...
112,100	Electric Construction, 1 to 112,100	2	5 %	6 %	6 %	2¼— 2½	2¼— 2½	...	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000 ...	2	7 %	7 %	7 %	3 — 3½	3 — 3½	...	...
140,300	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	103 —105	103 —105	104½	...
91,196	Elmore's Patent Copper Depositing, 1 to 70,000	2	...	...	...	⅜— ⅝	⅛— ⅜	⅝	...
67,275	Elmore's Wire Manufacturing, 1 to 69,385, issued at 1 pm.	2	...	...	...	¼— ½	⅜— ⅝	...	...
9,600*l*	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	7 %	...	10 — 12	10 — 12	...	...
12,500	Henley's (W. T.) Telegraph Works, Ord.	10	10 %	12 %	14 %	25 — 26	25 — 26	25	...
3,000	Do. do. do. 7 % Pref.	10	7 %	7 %	7 %	18½— 19½	18½— 19½	19¼	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½%	4½%	...	111 —116	111 —116	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	10 %	22 — 23	23 — 24	23⅝	22½
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	102 —106	102 —106	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	2⅞%	3¼%	3¼%	10¼— 10½	10¼— 10¼	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	14½— 15¼	14½— 15¼	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	37 — 41	38 — 42	41	39⅝
13,400	Telegraph Manufacturing, Ord. Nos. 6,601 to 20,000 ...	5	...	...	...	8¼— 9	8¾— 9¼	9¹⁄₁₆	...
13,400	Do. do. 5% Cm. Prf. Nos. 6,601 to 20,000	5	...	...	...	5¾— 6¼	5¾— 6¼	...	...
540,000*l*	Waterloo and City Railway, Ord. Stock	100	...	...	3 %	109 —112	109 —112 xd	112	111½

† Quotations on Liverpool Stock Exchange.
‡ Unless otherwise stated all shares are fully paid.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 10½.
British Aluminium, Ordinary, 10—12; 7 % Pref., 11—12.
House-to-House, 4½% Debentures of £100, 105—108.
Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 13¼; 1st Preference Cumulative 6%, £5 (fully paid), 7½—8. Debentures, 107—110. Dividend, 1898, on Ordinary Shares 10%.
National Electric Free Wiring, 10s. paid, 8/6 to 9/6.
Smithfield Market Electric, 4—4½.
*T. Parker, £10 (fully paid), 15½.

* From Birmingham Share List.

Bank rate of discount 3 per cent. (February 2nd, 1899).

MARKET QUOTATIONS, Wednesday, February 15th.

CHEMICALS, &c.	This week.	Last week.	Increase or Decrease.
a Acid, Hydrochloric .. .. per cwt.	5/-	5/-	..
a „ Nitric .. .. .. per cwt.	22/-	22/-	..
a „ Oxalic .. .. .. per cwt.	32/-	32/-	..
a „ Sulphuric .. .. .. per cwt.	5/6	5/6	..
a Ammoniac, Sal .. .. .. per cwt.	37/-	37/-	..
a Ammonia, Muriate (grey) .. per ton	£19	£19	..
a „ „ (white) .. per ton	£26	£26	..
a Bleaching powder .. .. per ton	£5 15	£5 15	..
a Bisulphide of Carbon .. .. per ton	£15	£15	..
a Borax .. .. .. per ton	£16 10	£16 10	..
a Benzole (90 %) .. .. .. per gal.	7/-	7/-	..
a „ (50/90 %) .. .. per gal.	5/6	5/6	..
a Copper Sulphate .. .. .. per ton	£25 10	£24	30/- inc.
a Lead, Nitrate .. .. .. per ton	£23	£23	..
a „ White Sugar .. .. per ton	£30 10	£30 10	..
a „ Peroxide .. .. .. per ton	£27 10	£27 10	..
a Methylated Spirit .. .. per gal.	2/9	2/9	..
a Naphtha, Solvent (90 % at 160° C.) .. .. per gal.	5/6	5/6	..
a Potash, Bichromate, in casks.. per lb.	3¾d.	3¾d.	..
a „ Caustic (75/80 %) .. per ton	£24	£24	..
a „ Bisulphate .. .. per ton	£35	£35	..
a Shellac .. .. per cwt.	67/-	67/-	..
a Sulphate of Magnesia .. .. per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers .. per ton	£6 15	£6 15	..
a „ Recovered .. .. per ton	£5 15	£5 15	..
a „ Lump .. .. .. per ton	£5 5	£5 5	..
a Soda, Caustic (white 70 %) .. per ton	£7 10	£7 10	..
a „ Crystals .. .. .. per ton	£3	£3	..
a „ Bichromate, casks .. per lb.	3d.	3d.	..

METALS, &c.	This week.	Last week.	Increase or Decrease.
b Aluminium Wire, in ton lots .. per ton	£224	£224	..
b „ Sheet, in ton lots.. per ton	£191	£191	..
c Brass (rolled metal 2" to 12") basis per lb.	8½d.	8½d.	..
c „ Tube (brazed) .. .. per lb.	10d.	10d.	..
c „ Wire, basis .. .. per lb.	8¾d.	8¾d.	..
f Ebonite Rod .. .. .. per lb.	3/-	3/-	..
f „ Sheet .. .. .. per lb.	5/-	5/-	..
g Copper Bars .. .. .. per ton	£79	£79	..
g „ Wire (basis price) .. per lb.	9¾d.	9¾d.	..
g „ Sheet .. .. .. per ton	£79	£79	..
g „ Rod .. .. .. per ton	£79	£79	..
n German Silver Wire .. .. per lb.	1/6	1/6	..
h Gutta-percha, fine .. .. per lb.	6/-	6/-	..
h India-rubber, Para fine .. per lb.	4/2	4/1½ to 4/2	..
i Iron, Charcoal Sheets .. .. per ton	£18	£18	..
i „ Pig (Cleveland warrants) per ton	48/6	47/9½	8½d. inc.
i „ Forgings, according to size per ton	From £11	From £11	..
i „ Scrap, heavy .. .. per ton	50/- to 55/-	50/- to 55/-	..
i „ Wire galvanised No. 8 .. per ton	£8 15	£8 15	..
g Lead, English Ingot .. .. per ton	£15	£15	..
g „ „ Sheet .. .. per ton	£15 15	£15 15	..
l Mica (uncut slabs 8" long) .. per lb.	6/6	6/6	..
m Manganin Wire No. 28.. .. per lb.	8/-	8/-	..
g Mercury .. .. per bottle	£8 5	£8 5	..
o Platinum .. .. per oz.	£3 6 6	£3 6 6	..
i Steel, Magnet, acc'd'g to desc'p'n p. ton	to £40	From £15	..
i Steel, Magnet, in bars	£58	£58	..
g Tin, block .. .. per ton	£115	£115	..
g „ foil .. .. per lb.	1/6	1/6	..
n „ wire Nos. 1 to 16 .. .. per lb.	1/6	1/6	..
j Yarns, Cotton, Single 10lb. bundles pr lb.	6¼d.	6¼d.	..
j „ Flax, 6 or 8 lea... .. per lb.	4d.	4d.	..
j „ Hemp, 8 ply 10 lbs. .. per lb.	3¾d.	3¾d.	..
j „ „ Russian, 10 lbs. per lb.	4½d.	4½d.	..
j „ Jute, 180 lbs. rove .. per ton	£12	£12	..
j „ Manila, 24 thread .. per ton	£30	£30	..
k Zinc, Sheet (Vielle Montagne bnd.) p. t.	£31	£31	..

a Quotations supplied by Messrs. G. Boor & Co.
b „ „ „ The British Aluminium Co., Ltd
c „ „ „ Messrs. Thos. Bolton & Sons.
d „ „ „
e „ „ „
f „ „ „ The India-Rubber, G.-P., and Teleg. Works Co Ltd
g „ „ „ Messrs. James & Shakspeare
h „ „ „ „ Jackson & Till.
i Quotations supplied by Messrs. Bolling & Lowe.
j „ „ „ „ Henry C. Yeo & Co.
k „ „ „ „ Morris Ashby, Limited.
l „ „ „ „ Sanders, Wake & Co.
m „ „ „ „ W. T. Glover & Co., Ltd.
n „ „ „ „ P. Ormiston & Sons.
o „ „ „ „ Johnson, Matthey & Co., Ltd.

NERNST'S ELECTRIC LIGHT.*

By JAMES SWINBURNE.

Before describing Nernst's invention, it may be profitable to spend a few minutes reviewing the position of electric lighting. The whole industry is at present controlled by the incandescent lamp. We are so accustomed to this, and it is taken for granted in such an unconscious way, that we do not realise how much everything depends on the maker of the carbon incandescent lamp.

In very early days, that is to say, in the early eighties, there were a few Edison lamps at 100 volts, with an efficiency too horrible to mention, but the Swan lamp came along made for 50 volts. I say made for 50 lights advisedly; I mean that the makers tried to make 50-volt lamps; and produced lamps taking from 40 to 60 volts. If the lamps were not bright enough you ran the engine faster, or put a smaller pulley on the dynamo. (The belt then generally slipped, but that is not to the point.) For about four years, which is a long period in the development of such a rapidly growing industry as electrical engineering, the makers of incandescent lamps, or, in fact, the makers of the Swan lamp, decreed that the electromotive force used should be from 40 to 60 volts. There was no appeal. There was no development of central station supply at that time, but still, even then in large buildings there was the longing for higher pressures on account of the cost of the mains.

About 1885, the Swan 100-volt lamp came into use. It was a clumsy affair, with little loops of platinum at the sides. At first the lamps were pretty bad, but they gradually improved; and 100 volts, or in some cases 110 volts, became the recognised pressure for electrical supply.

As town lighting from central stations came into being, the limit of 100 volts became a serious trouble, and the evil was partly mitigated by the use of three or even five-wire systems. I must point out that the incandescent lamp exercises its tyranny in two ways. It not only insists on a low pressure, such as, say, 100: and thus demands large leads to feed it, but it is so sensitive to variations of pressure that the system of distribution has to be arranged to give a practically uniform pressure at the terminal of the lamp. The necessity for uniform pressure probably gives more trouble, and costs more than the mere low pressure; and it would be cheaper to supply at 100 volts with a good margin of permissible variation of pressure than supply at 200, with a very small percentage of variation.

Quite lately the incandescent lamp makers have produced things called 200-volt lamps, and some make them for 250 volts. So there is a general tendency on the part of supply companies to jump to a 200-volt supply. The innocent consumer is therefore pressed by the company to change over to 200 volts. The company likes the change very much, and the lamp maker also enjoys it, as he makes more lamps and charges more for them.

Considering the enormous importance of the incandescent lamp, its improvement has received extraordinarily little attention. It limits us as regards pressure, it used to hamper us by its cost, it limits us as to variation of pressure, and it limits us very seriously by its inefficiency. Yet, in spite of these, the carbon incandescent lamp has made practically no advance in 15 years. Of course, mere detail improvement in manufacture has taken place, and this has led to better quality and greater uniformity, hence cheapness; but there has been no radical improvement. The jump to 200 volts from 100, or from 50 to 100, did not depend on any sort of radical improvement in the incandescent lamp; it was merely the result of detail improvements, making it possible to produce long thin filaments. Other things being equal, it is easy to see that the long thin filaments must be weaker. If the carbon has the same specific resistance, the relation between pressure and length is $E = L^{\frac{3}{2}}$, and $E = D^{-\frac{3}{2}}$. If the filaments are flashed, the proportions will be still more extreme. The question of high pressure incandescent lamps is thus—How far can we make the filaments longer and thinner and flimsier without exasperating our consumers? Unfortunately the consumer is rapidly getting saddened as it is. The 100-volt 8 C.P. lamp does not please him much, and the 200-volt 8 C.P. lamp has in no way delighted him; if the lamp is made with two 100-volt filaments in series, it combines the disadvantages of both, without the advantages of the small candle-power of either. But it adds some further disadvantages peculiar to the higher pressure which I have not so far touched upon, and that is that the higher the pressure the more troubles there are through the silent discharge, or whatever it is called. I need only refer to the well-known experiment, in which a third terminal is sealed into the lamp. A galvanometer then shows a current going across country inside the lamp. This is no doubt intimately connected with the life, or rather with the death of the lamp.

I have dealt with the question of high pressure incandescent lamps at some length because the subject is really of vital importance, and is too much neglected. Our technical colleges, and our technical press, and our technical societies pay the greatest attention to questions of a per cent. or two in the efficiencies of dynamos and transformers, and give a good deal of attention to engines and boilers. That is because there is plenty of room for calculations in connection with these subjects; but the incandescent lamp, which at present holds the whole career of the lighting industry in the little curl of flimsy red-hot carbon that can hardly support its own weight, receives no attention at all. How much does the average electrical engineer know about incandescent lamps? The only subject that is treated in the same way is the cable. About half the money in town lighting goes in the cable, a mere fraction in the dynamos and transformers themselves; so the average electrical engineer knows nothing about cables.

So far I have only discussed the incandescent lamp; the arc lamp has also to be considered. I will not say much about the arc lamp just now, but will add a little more when the Nernst lamp is compared with it. The ordinary arc is limited in pressure to about 50 volts, including the series resistances necessary for regulating. The enclosed arc is a new development, which is more satisfactory as regards pressure and as regards consumption of carbon.

The lamp I describe to-night is the invention of Prof. Walther Nernst, of the University of Göttingen. Though he is a young man, Prof. Nernst's name is already known to all modern chemists as a leading authority and original thinker in the field of physical chemistry. It is unusual for a man who has climbed to the top of one tree to jump to the top of another.

Nernst's, like most great inventions, is exceedingly simple as soon as it is understood. The efficiency of an incandescent body, as far as radiation goes, depends simply on the temperature. The efficiency of an incandescent lamp, for instance, depends on the temperature of the filament only, providing there is no loss by convection. The carbon will not stand a sufficiently high temperature, especially as, in addition to its low specific resistance, the filament has to be long and slender, and thus weak. Nernst, therefore, chose a material that would stand higher temperatures than carbon, and his material has the incidental advantage that its specific resistance is so high, that strong rods can be used for high pressures instead of thin filaments. The most refractory materials so far used in lighting are zirconia, which has been used to replace lime in the limelight, and the oxides, or so-called rare earths, in the Welsbach mantles. I am aware, of course, that many people suppose that the Welsbach mantle is not very hot, treating it as if it were at a temperature, for instance, below the melting point of platinum. The light emitted is supposed to be due to some special power of selective emission, due to the oxides employed. I have had a good deal to do with incandescent gas mantles, and I find no reason to suppose there is any magic effect of this sort going on. The part of the flame where the mantles hang fuses platinum wire easily, and very few materials can stand the temperature without fusing or volatilising. Lime and many other oxides volatilise slowly from the mantles. I do not mean that the mantles are above the boiling point of lime. I have some idea of its melting point, as I have made a few pounds of melted lime and run it out on the floor to look at it. The Welsbach mantles, which are now chiefly thoria, are at a temperature near their softening point, and in the making are raised to a temperature at which they begin to soften.

Nernst takes highly refractory oxides as his material. It does not seem promising, because such oxides are notoriously good insulators. But such insulators are electrolytes when hot. Nernst, therefore, heats the rods to make them conduct, and then heats them electrically, preserving a temperature which is within the limits that the material can bear without softening. This means that he can take the most refractory bodies supplied by the whole range of chemical research, and can heat them to a temperature short of their softening point, and can thus get an efficiency unknown to workers on the incandescent lamp. Such efficiency also means whiteness of light, so long as the efficiency is not too high. Thus the crater of the arc being at a temperature of boiling carbon, gives a light that is unpleasantly blue.

The material is worked up into little white rods. Each rod is mounted on two platinum wires, a little paste made of refractory oxides being applied to the joints. The little rod with its two wires is then mounted in a holder which fits ordinary electric light fittings. As the rods fall in resistance as the temperature increases, after the manner of electrolytes, an increase of current produces a decrease of resistance. This tends to give some instability in running in parallel on supply circuits. This instability is corrected, as in an arc lamp which has analogous properties, due to a different cause, by a series resistance. The Nernst rod has therefore a resistance in series. This is made up of exceedingly fine wire, and for ordinary circuits amounts to 10 or 12 per cent. of the whole resistance of the lamp. The consumption, including the resistance, is 1·5 watts per candle for large lamps, and 1·6 for small lights or low pressures. In small or low pressure lamps the loss of heat at the ends is larger in proportion.

Such a lamp as I have described will not light up of itself, for the rod is an insulator when cold. The simplest way to start it is to warm it up with a match, or better with a small spirit-lamp. Such a lamp as this is not only very cheap as regards first cost, but very economical in running. The life of rods, running at an efficiency of ¾ of a candle per watt, including the resistance, is already more than 500 hours in good specimens. If the Nernst lamp advances as much in the first few years of its existence as the carbon lamp did between 1880 and 1882, it will soon be made so well that the rods last a life-time. When the rod is worn out a new rod with its wire mounts is all that is replaced. The whole lamp is not thrown away at all.

The method of lighting I have described, though it may be used in many cases, such as large public rooms, is really a savage mode of ignition, fit only for dealing with uncivilised commodities, such as gas and tobacco.

The small lamps and the lamps of medium size are in practice started by a heating resistance. This is arranged close to the rod, and in shunt to it. As soon as the rod is hot enough to conduct, its current works a tiny cut-out in the resistance circuit. In large lamps the heating system is a little more elaborate, as the resistance arrangement is arranged as a sort of hood which covers the rod. As soon as the rod conducts, not only is the resistance circuit broken, but the electro-magnet lifts the little hood clear off the rod. In all these forms, the rod and its mounting are replaceable without interfering with the rest of the lamp.

We now have to consider the part the Nernst lamp is probably going to play in the near future.

* Society of Arts, February 8th. Reprinted from the *Society of Arts Journal*.

Compared with the small incandescent lamps, as you deal with a material of much higher specific resistance, it is easy to give both small lights and high pressures. The question of lighting is exceedingly important, though it appears trifling at first sight. People are so accustomed to lamps being turned on from the door without any further trouble that they will generally object to having to light them with matches or spirit lamps, but there are many cases in which it will be quite satisfactory to have one lamp with an automatic lighter to show you the way into the room, the rest being lighted with matches or a spirit lamp as needed. There will be, however, a considerable opening for the cheap, small power, high efficiency lamp, and the disadvantage as to lighting is small in such cases as cafés, restaurants, churches, hotels, railway stations, and in short, in most public rooms, is small.

Coming now to the next size, that is to say, lamps of 20 to 200 candle-power, and even small lamps in which it is worth while to have automatic ignition, the first cost of such lamps will be higher than the first cost of incandescents, but as the rod itself has alone to be replaced, that is a matter of very slight importance. This size of Nernst lamp has, further, every chance of completely ousting the carbon incandescent on the score of cheapness, as to renewals, higher efficiency, better coloured light, and perhaps more especially high pressures. Once the Nernst lamp becomes so general that systems of distribution are laid out to suit it, instead of to suit the carbon lamp, the carbon lamp is practically "out of the running." It must be remembered that the Nernst can compete with the carbon filament at any pressure that suits the filament, but the Nernst lamp can easily go right out of the depth of the filament and have the higher pressures to itself. It must be remembered that at present the cost of cables in a system of distribution is an exceedingly large item.

Turning now to the large lamps, they compete with the arc lamp in efficiency. Of course the efficiency of the arc lamp is not a very definite quantity. The candle-power is generally determined by multiplying the current by two and adding zeros at discretion. All I can say is, that however many zeros the good nature of the maker may supply, a Nernst lamp taking the same power gives a better light. When carefully arranged on the photometer, the arc may be better in given directions, but a lot of light given in directions that you do not want is not the same as the same light distributed with a uniform spherical emission. The arc lamps shown here will give the audience a good idea of the relative values. The Nernst gives a pleasanter, and, of course, a perfectly steady light. Coming to costs, the Nernst will be very much cheaper in first cost, but enormously cheaper in maintenance. It also goes quite away from the arc as to pressures. There is no trouble, for instance, in making large lamps to work in parallel at 500 volts, and by using double rods, at 1,000 volts. This puts an entirely new development of electric lighting in the hands of the engineer.

There is one point I have said little about yet. The incandescent lamp which is still with us gives trouble not only because of the low pressure it needs, but also because it demands that the pressure shall be kept uniform. It seems quite possible that the Nernst lamp may be made to stand a much greater variation of pressure than the filament. If this proves true, it means an enormous difference in the designing of distribution mains. I do not like to say much about this yet, as the invention is too young, and too little time has been available to make much certain progress in that direction. Results are promising, but it is best not to be sanguine.

It is difficult to discuss an invention like this without being carried away by enthusiasm. I feel, however, that I have but feebly shown forth the probable future of what seems to me the greatest invention in electric lighting that we have seen for many years. Still, I am sure I have not been too sanguine.

DISCUSSION.

The Chairman, in inviting discussion, said Mr. Swinburne had fascinated them all by the manner in which he had put forward all the good points of the Nernst lamp, including the possibility of going back to old habits and lighting electric lamps with a match.

Prof. Ayrton, F.R.S., congratulated Prof. Nernst on having achieved such a wonderful result by such simple means, viz., rendering an insulator conducting by heating it; and Mr. Swinburne on the way in which he had put the matter before the meeting. The knowledge that an insulator could be made to conduct electricity by heating it was much older than the recent experiments of Sir W. Roberts-Austen, for some 23 years ago a paper appeared in the *Transactions of the Royal Society* on that very subject of the extraordinary diminution of resistance in a solid electrolyte by heating. In Japan, plates of zinc and copper were put on each side of a glass plate, which was heated, and the electromotive force passing, as indicated by a high resistance voltmeter, after short circuiting the cell, appeared almost as rapidly as if the plates had been immersed in dilute sulphuric acid. It had also been known ever since carbon filament lamps had been on the market that there were certain difficulties connected with them, and many experiments had been made, and patents taken out, with the object of using refractory earths, but, apparently, no one before Prof. Nernst had thought of the simple expedient of heating a very good insulator with a match or spirit lamp, applying a current of suitable potential, and thus obtaining a brilliant light, such as they had now seen for the first time. This result was clearly of an enormous commercial importance, and would be an entirely new departure in glow-lamp electric lighting. It was also extremely interesting from the purely scientific side, touching on a question which Mr. Swinburne had passed over rather lightly, as if it was only a few foolish people who fancied there was something in the Welsbach mantle which they did not entirely understand. This invention showed, at any rate, that illuminating gas was not necessary for obtaining light by incandescence from the rare earths. Some five or six years ago he asked an assistant of his to look up the literature on the subject of the Welsbach burner, and see if any report had been made throwing any light on the question whether the effect of the burner depended solely on the high temperature. He gave him a reference to a German paper in which experiments were quoted, which seemed to show that the high temperature was not the sole factor. Later on he discussed the matter with a very distinguished English chemist, who agreed in the view that it was not solely a question of temperature, and a year or two afterwards he again discussed it with Prof. Elihu Thomson in America, who took exactly the same view. Many people thought that the material of which the mantle was made had the power of absorbing oxygen from the air or the gas, and compressed it, much as spongy black absorbed hydrogen and oxygen, and so caused these gases to burn under considerable molecular pressure. It was not merely that the Bunsen flame raised the material to a high temperature, but that the gas and air were compressed together in the pores of the material, so that the gas was burnt under pressure, and so you got a much higher temperature than you otherwise would. In the glow lamp, as they were not dealing with gas, it did not seem that the materials could play any such part. There seemed to be something in that idea, because it was necessary for the mantle to be a certain exact composition; you could not take thoria or zirconia at random and use it; you must have a certain definite combination to produce an efficient mantle. In fact, it was the addition of 0·4 per cent. of ceria which converted the Welsbach burner from a ghastly failure commercially into a wonderful success. He should like to know whether the mantle was not at a much higher temperature than the flame which surrounded it, and whether a particular combination of materials did not reach a much higher temperature than another combination immersed in the same flame. If so, it not merely the temperature of the flame which produced the result. There was one great advantage about the Nernst lamp, it did not seem to require a thin glass bell and a vacuum, and thus got rid of a very serious difficulty, because these bulbs were very fragile, and were easily destroyed by a touch of a broom or carelessness in carriage; many lamps also were defective, not from any fault in filament, but because the vacuum was imperfect. He should like to know the reason of the difference in the colour of the light of the Welsbach and the Nernst lamps—was it a difference in material or in temperature? He understood from his colleague, Dr. Armstrong, who visited Prof. Nernst some time ago, that it was essential to use an alternating current, as with a direct current the incandescent rod soon ceased to make good contact with one of the platinum terminals.

Mr. Hiram Maxim said he had always understood that the light in the Welsbach burner did not depend entirely on the temperature. There were many things in nature which gave light without any heat at all; such were glow-worms and fireflies. His opinion was that any substance, if there were any which did not volatilise at all, would give a light proportionate to the temperature; that platinum or iridium, or iron, if the iron was not burnt, would all give the same light at the same temperature, provided none of the material was wasted. Of course, if the least particle passed into the air, the flame would be coloured. In all probability the light emitted did not increase as the temperature directly, but as the square, some said as the cube, and some said as the fifteenth power of the temperature, and he was inclined to think that a slight increase in temperature increased the lighting power a great deal. In the Welsbach burner the light was not white, and that, he thought, indicated that some change was going on which made the apparent light higher than that due merely to the temperature. If carbon were heated to the same temperature, it would not give the same light.

Mr. R. S. Erskine said it would be an enormous advantage to central supply stations when these lamps came on the market. There was a great difficulty in getting satisfactory 200-volt lamps, though he did not know that they were much worse than the 100 volts. The fact was the public were now educated up to a much higher standard of light, and wanted much more than satisfied them some years ago, when they were only used to candles and ordinary gas burners. Those who were formerly well satisfied with two wax candles in their dressing room would now put up two 32-candle-power lamps over their dressing table, and the lighting all through the house was on the same scale. They were not content with an 8-candle-power lamp that gave 8 candles, but wanted it overrun so as to give 10 or 12 candles, and the 200-volt lamps would not stand this; the old 100 volts stood it to a certain extent, but soon got inefficient. The great trouble with all central stations was that the lamps took more current than they used to. It looked as if these lamps would give the public what they wanted at a reasonable price.

Mr. W. M. Mordey thanked Mr. Swinburne for speaking the truth about the 200-volt lamps. The supply of lamps was a matter which really required attention, because it led to a great deal of dissatisfaction. He thought the correct plan would be for the companies to supply not electricity, but light; and instead of persuading customers to buy lamps of any particular kind, they should make an inclusive charge, and supply them with lamps themselves, this would prevent dissatisfaction. He congratulated the society on this paper, which he thought would mark a new epoch in electric lighting; it was the first page in a new volume, recording an invention which would rank with that of the Swan lamp, since which there had been nothing brought forward so pregnant with results. They must also congratulate Prof. Nernst on his invention, and take care that he had the credit of it, and was not robbed by a number of people, who would be immediately writing to the *Times* to say that they did the same thing in their back kitchen 20 years ago. That was what always took place in the case of a new invention. Mr. Maxim had anticipated what he was about to say about the glow-worm. Prof. Langley, in America, dealt with the radiation from fireflies and glow-worms in a paper a

few years ago, and gave a diagram showing the total radiation, and what proportion was luminous; the result proving that the glow-worm had solved the problem which Tesla, Hertz, and many others had been working at, of making nearly the whole of the rays luminous. If they could only get a glow-worm to come and read a paper explaining how it was done, Dr. Nernst's lamp would have no future before it. One advantage these lamps possessed was that they would be able to light their cigars and pipes at them. He agreed with Mr. Swinburne that the possibilities of the carbon filament were about exhausted; there had been very little improvement for a long time, and it was a remarkable thing that just when the carbon filament was failing to meet their requirements, this new invention should be made, which seemed to meet the case. It was like the discovery of gutta-percha at the critical period, which got electric cable makers out of their difficulties. But, though the new lamp was evidently a very robust child, it was still a child, and it would at any rate take a little time to displace existing lamps. If lamp companies' shares went down at all on account of the Nernst lamp, he would like to buy some, as they would have time to rise again before the incandescent carbon disappeared.

Dr. FLEMING asked if there was any deterioration in the quality of these lamps after a time, such as occurred with carbon filaments and Welsbach mantles; because this would be very important in considering the commercial value of the invention. If the lamp only required 1 watt or 1½ at starting, and, after a few hours' work, 4 or 5, it would be a serious disqualification. It was well known that most of these radiants did deteriorate after a time; with the lime-light, for instance, after a few minutes, the radiant quality of the lime diminished, although it was played upon by an oxy-hydrogen flame at a constant temperature; and turning the lime round would markedly increase the amount of light on the screen.

Major FLOOD PAGE, having congratulated Mr. Swinburne on his paper, said he was much interested in this subject, though he was not a scientific man. When he saw Prof. Nernst some months ago, in Germany, he was very much astonished to find that so young a man had been able to attain such a high scientific position. Mr. Swinburne had spoken of the carbon lamp having reached finality, but he might say those connected with carbon lamps, as he was, were as much interested as anyone in this new departure. They had a higher interest than that of any particular lamp, and that was in the advance of electricity. He quite agreed that nobody but Prof. Nernst could claim the credit of this invention. It was one everybody had been expecting, and it could be worked in conjunction with existing systems, so that all who were connected with electric work would find themselves indebted to Prof. Nernst. In the old days they had had Maxim, Edison, and Swan; and some people thought one was going to kill the other, but instead of that they all helped the general advance. This was, to a certain extent, going back, for Swan first worked at a rod, but, he believed, it was an advance which might benefit all connected with electricity.

Mr. H. COLEFAX said several applications for patents had already been put in, which appeared to claim the benefit of this discovery, but he did not think they would prove successful. With regard to the question of deterioration, he was told by Prof. Nernst, some eight months ago, that, as far as he could discover, these lamps did not deteriorate in use; of course, this could only be proved by experience, but if it were so it would be very remarkable, seeing that in every other form of incandescent lighting yet tried there was this deterioration. He should be glad if Mr. Swinburne could tell them what it was which limited the life of the filament, because, when he saw Prof. Nernst, he did not think he had then arrived at any explanation. He was astonished at the progress which had been made in the eight months since he first saw the invention; the limit then was 200 hours, the first experiments only having attained 40 hours.

Mr. CAMPBELL SWINTON said Prof. Ayrton was not strictly accurate in saying that this was the first attempt to use a heated electrolyte. Some 20 years ago Jablochkoff showed a lamp in London consisting of a strip of kaolin, along the top of which he put what he called a match, which consisted, he believed, of carbon mixed with treacle; this conducted the electricity—100 volts—until it heated the kaolin, and that then formed the conductor. He would not go into the question of how far that was an anticipation of the present invention, he only wished to correct the impression that nothing of the kind had been tried. They must all admire the great advance which had now been made, and they knew that the Jablochkoff lamp never came to anything. With regard to the lighting power of incandescent gas mantles, he had many experiments on them with cathode rays, by which you could heat them to a very high temperature without the use of gas in the ordinary sense, and he found there was no appreciable difference in the amount of light given by a mantle of pure thoria and one with the addition of a small percentage of ceria.

Mr. SYDNEY MORSE said he was interested in this question on the commercial side, and especially as connected with the competition of municipal authorities, who were now commencing to manufacture and sell electric fittings, which he feared would seriously interfere with the progress of invention. They had heard that invention in conjunction with carbon filaments was exhausted, but this opened up a new industry, which he hoped would be taken up and improved by English engineers and inventors, for they could not suppose that everything had yet been done.

Mr. J. G. LORRAINE asked what amount of heat was emitted by this lamp compared with an ordinary incandescent one.

Mr. A. H. DYKES asked what was the power required for these lamps. He had been working out a scheme for street lighting, and he found the difficulty was that, while arc lamps were too large, ordinary incandescent lamps were not a great success. This lamp appeared to have many advantages for such purposes, and particularly the volume of light-giving material, being so much larger than a carbon filament, it would have much greater penetrative power in foggy weather. With regard to lighting up, a man could go round and apply heat underneath these lamps as well as he could turn on the ordinary gas lamps.

Mr. SWINBURNE, in reply, said the question of the temperature of a Welsbach burner was a very large subject, with which he could not attempt to deal fully. If you examined a burner with the mantle off, there was a zone of very high temperature, which would easily fuse platinum; but most measurements made were erroneous, because they were taken with a thermopile, which never got the real temperature of the burner; the great difficulty was to get what was in the burner to the temperature of the burner. In dealing with the light given by incandescent bodies it must be remembered that the light depended on the emissivity. If the only temperature at which you got much light was very high—very close to the temperature of the gas—you must use something of very low emissivity; if it were large, the heat given by the burner was rapidly given off, and if infinite the temperature of the mantle would remain at the average temperature of the room, and you would not get any light. On the other hand, if the emissivity were very low, though the mantle would get to a high temperature, it would not give light for want of emissivity. A pure white body, such as pure zirconia, gave very little light, because the emissivity was too low, though the temperature was high. To get the highest efficiency you must have emissivity enough to give plenty of light without robbing the flame of its heat too soon. From a white oxide like thoria you did not get much light, but if you added a small percentage of ceria or some other coloured oxide—it did not matter much what—you got light. A great deal of unnecessary mystery had been introduced into the subject because it was known that erbia gave some curiously characteristic spectra, but erbia was only present as an impurity. Another point was that cerium had two sets of compounds, and it was supposed that it was continually hopping backwards and forwards from one state of oxidation to another. In dealing with a subject like this, he thought the proper way was to take a simple explanation if it fitted the case, and only if it did not go to a more complicated one. He saw no reason to suppose that temperature did not account for the results, if it would fuse platinum, and if it would soften the mantle, as it would. In making Welsbach mantles—though having advised the company he must not say everything he knew—they were sometimes raised to such a high temperature that they softened, and then they gave more light. Prof. Ayrton had quoted several anonymous authorities, but had not given the reasons for their opinions, and so it was impossible to deal with them. They involved questions of thermo-dynamics into which there was not time to go. The case of spongy platinum was altogether different; there was a chemical combination started by the heat, which would not otherwise take place. Here there was no reason to suppose there was such a combination; spongy black would give no light, and a solution of platinum put upon a mantle would destroy its light-giving power. He believed that colour was largely a question of temperature; but you could produce different colours by using different materials. The emission was the complement of the absorption. A blue body when heated gave an orange light. With regard to a vacuum, its effect was to get rid of convection. If you tried to heat a long thin filament of carbon, it would be inefficient on account of convection; but with a short, thick rod the convection was not serious. Practically, he believed these Nernst lamps would not work in a vacuum. He had not tried many experiments himself, but so he was informed. The reason generally given was that electrolysis was going on, and that oxygen was being absorbed from the air at one terminal, and being given off at the other. That was Prof. Nernst's explanation, but he thought there was another factor to be taken into account. It was perfectly simple on paper to electrolyse salt and get out chlorine and sodium; but when you tried it you did not get either. The reason appeared to be that the chlorine and the metal were dissolved to some extent in the fused bodies, and got across very quickly. He did not think true electrolysis took place to any extent, but there was a continual diffusion of the substances across which was undoing the work of electrolysis all the time; but that was not sufficient to make it work properly in a vacuum. All the lamps shown were on the alternate current, but he had tested them with the direct current, and found their efficiency continued right through. That was some six months ago, when they lasted 200 hours. Now they had got to 500 hours, and he had no doubt they would go much higher. He did not know anything about glow-worms, and doubted whether anyone else did; but he did not think such questions had much to do with the matter; it was more a question of the red-hot poker order, quite simple. With regard to the emission of light at a given temperature, it was not the least likely that there was any such simple law as Mr. Maxim had suggested. The simple law would be as to the emission of power or energy. Light was only a certain small octave of vibrations that affected the human retina; it was not distinct from heat or the radiations of still higher frequency. It was not likely there was any definite law as regarded light; probably it depended, for one thing, on the eye looking at it. With regard to deterioration and its cause, after running some time the material appeared to get crystallised; what else happened he did not know. Probably there was a gradual tendency for the rod to get uneven; then it would get more heated in one part, and softer, until at last it melted. Prof. Ayrton seemed to think that the compound in the Welsbach mantle was chosen entirely for giving light; but anyone who used those lights knew that the strength of the mantle was of great importance. You could get a very good light from yttria, but you could not get a strong mantle that would not warp. The manufacturer had to consider strength, portability, and durability; and one point about that was that both the Welsbach and Nernst were at a very high temperature, just short of the fusing point, at which the material very slowly evaporated. If you took a thoria mantle and put lime on it, it would give a very nice light at first, but the lime would

soon volatilise; so would many other substances. Ceria went off quicker than thoria, and the result was that after running a thoria mantle with a small amount of ceria for some time you had a pure thoria mantle. It was not that the power of the ceria was exhausted, but that it was not there. He did not know what caused the deterioration of the limelight. Probably the lime began to sinter together, and therefore you did not get the same temperature as before. He congratulated Major Flood Page on the exceedingly broad-minded view he had taken of the subject. With regard to the early Jablochkoff lamp he had no information. His own impression was that the Jablochkoff candle was the only thing which was at all successful. That was in use in 1878. There was another lamp which depended on a hot material between the poles, called the Lampe Soleil, in which an arc was struck across a surface of marble, which got very hot, and finally conducted and gave an illuminant surface. The cathode rays experiments referred to by Mr. Swinton, bore out what he had said about the earths, that it was simply a question of temperature. There was another inventor, he believed, working on a lamp with cathode rays, and no doubt they could be made to give an efficiency equal to the Nernst if the earth were raised to a sufficiently high temperature. With regard to the amount of heat given off, it depended on the amount of power used. If you took 100 watts, probably nearly 100 would go off in heat, as only a small percentage of the energy was converted into light, and until Mr. Maxim and Mr. Mordey could tame their glow-worms, he was afraid it would always be so.

The Chairman, in proposing a vote of thanks to Mr. Swinburne, reminded the audience that, with all their enthusiasm, the commercial success of this new lamp depended on the price at which it was offered, and as to this they had, as yet, no information. When electric accumulators were first discovered, it was supposed they would revolutionise the industry, and do all sorts of wonders; but though they had been certainly useful, they had not done what was expected of them. In the case of these lamps, if they were sold at 1s. 1d., all charges included, and an ordinary carbon lamp was sold at 1s., he feared the latter would be generally purchased.

The vote of thanks was carried unanimously, and the meeting adjourned.

THE WORK OF THE REICHSANSTALT AND OF THE VERSUCHSANSTALT, BERLIN.

With reference to our leading article of October 14th upon the proposed National Physical Laboratory at Kew, the following summary of the work carried out at the Reichsanstalt, and at the Versuchsanstalt, Charlottenburg, in recent years, will be of interest to our readers. These two institutions in Berlin are State supported, and are intended to be supplementary, the one to the other. The former is engaged chiefly with the investigations relating to physical constants, the latter with the practical questions arising in the applications of science to industry.

The publication of the results obtained by the workers in the Reichsanstalt, commenced in 1894, and the following subjects, are dealt with in this, and in the succeeding volume:—

1894.—Vol. I.

The inception and aims of the Reichsanstalt, by v. Helmholtz.
Mercury thermometers; their manufacture and calibration.

1895.—Vol. II.

Comparison of thermometers.
The expansion by heat of solid and semi-solid bodies.
The variation in the force of gravity with height.
The optical properties of quartz in sodium light.
The value of the ohm.
The determination of electrical resistance.
The normal ohm at Charlottenburg; mercury and wire.

The results of the investigations carried on at the Versuchsanstalt have been published continuously since 1883, and the 16 volumes containing the records of the work during the period 1882—1897, form a most valuable addition to technical literature.

It is regrettable that the various English technical papers or journals devoted to the subjects with which these investigations deal have not made greater use of these volumes for the benefit of their readers. The Committee upon the Deterioration of Paper, appointed in 1896 by the Society of Arts, has, it is true, published abstracts of all the original investigations carried out at the Versuchsanstalt relating to paper, but beyond this we are not aware that any other industry in this country has had its attention called to these valuable publications. The following list of investigations, of which records are published in the 1896 and 1897 volumes, shows the character and scope of the work carried on in the Versuchsanstalt.

1896.

Three investigations by Prof. Martens, director of the laboratory, relating to the strength of compressed gas cylinders, the strength and microscopic structure of iron rails, and the methods of conducting pressure tests with solids.

Two investigations by Dr. Rudeloff, bearing upon the strength and elasticity of building materials, and the physical characteristics of iron nickel alloys.

Four series of tests by Dr. Gary, relating to the manufacture and examination of cement, tiles, and bricks.

Numerous investigations by Dr. Herzberg, bearing upon the manufacture and testing of paper and cardboards.

Five inquiries by Dr. Holde, relating to the examination of oils and fats, and to the saponification of liquid fats.

1897.

One investigation by Prof. Martens, bearing upon the hardening of mortars and of concrete.

Five investigations by Dr. Rudeloff, relating to the strength of pine wood, of wire rope, and of hemp rope, the influence of temperature upon elasticity tests, and the suitability of certain materials for railway construction purposes.

Three inquiries by Dr. Gary, dealing with the testing of natural rocks and stones, of artificial asphalt, and of old mortars, and short notes upon faulty tiles, faulty cement, and the use of refuse from sewage works.

Numerous investigations by Dr. Herzberg, relating to the manufacture, classification, and testing of writing, printing, and packing papers.

One investigation by Dr. Finkener with reference to the composition of iron sheets and tubes in which faults have become manifest.

The proposed extension of the existing Physical Laboratory at Kew will, of course, still leave us far behind our German rivals in the matter of State aid and equipment for this kind of research work; but now that a beginning has been made, we may confidently expect further developments, and possibly a Werner v. Siemens may arise on this side of the Channel to endow the new National Physical Laboratory with ample means for the erection of new buildings, and purchase of all the apparatus required in its future work.

PHYSICAL SOCIETY.

Annual General Meeting, February 10th, 1899.

Mr. Shelford Bidwell, F.R.S., President, in the Chair.

The report of the Council was read by Mr. H. M. Elder. Dr. Atkinson then presented the treasurer's report, and showed that although there was only a small balance in the bank, the financial position had somewhat improved. The list of Fellows lost to the Society by death was read; the obituary includes the names of Latimer Clark, C.E., F.R.S., Sir James Douglass, F.R.S., John Hopkinson, D.Sc., F.R.S., J. E. Myers, Eugene Obach, Henry Perigal, F.R.A.S., and Bartholomew Price, M.A., F.R.S. After some remarks with regard to the library and the subscriptions, votes of thanks were passed to the Council, the auditors, and to the other officers of the Society. The president then moved a vote of thanks to the Chemical Society for the use of the rooms at Burlington House.

Council and officers for the forthcoming year were elected as follows:—President, Oliver J. Lodge, D.Sc., F.R.S. Vice-presidents who have filled the office of president:—Dr. J. H. Gladstone, F.R.S., Prof. G. C. Foster, F.R.S., Prof. W. G. Adams, M.A., F.R.S., The Lord Kelvin, D.C.L., LL.D., F.R.S., Prof. R. B. Clifton, M.A., F.R.S., Prof. A. W. Reinold, M.A., F.R.S., Prof. W. E. Ayrton, F.R.S., Prof. G. F. Fitzgerald, M.A., F.R.S., Prof. A. W. Rücker, M.A., F.R.S., Capt. W. de W. Abney, R.E., C.B., D.C.L., F.R.S., Shelford Bidwell, M.A., LL.B., F.R.S. Vice-presidents:—T. H. Blakesley, M.A., C. Vernon Boys, F.R.S., G. Griffith, M.A., Prof. J. Perry, D.Sc., F.R.S. Secretaries:—W. Watson, B.Sc. (Physical Laboratory, South Kensington), and H. M. Elder, M.A. (50, City Road, E.C.). Foreign secretary:—Prof. S. P. Thompson, D.Sc., F.R.S. Treasurer:—Dr. E. Atkinson. Librarian:—W. Watson, B.Sc. Other members of Council:—Prof. H. E. Armstrong, D.Sc., F.R.S., Walter Baily, M.A., R. E. Crompton, Prof. J. D. Everett, D.C.L., F.R.S., Prof. A. Gray, LL.D., F.R.S., E. H. Griffiths, M.A., F.R.S., Prof. J. Viriamu Jones, M.A., F.R.S., S. Lupton, M.A., Prof. G. M. Minchin, M.A., F.R.S., and J. Walker, M.A.

The newly-elected president, Prof. Oliver Lodge, then took the chair, and an ordinary meeting was held. In his address he referred to the heavy death roll of the Society during the past year, and to the tribute paid to the memory of John Hopkinson at Cambridge University. Prof. Lodge then commented on the quickness with which scientific discoveries were now applied to practice, and to the interest taken in such applications by men of science. He did not know whether this was due to the example and inspiration of Lord Kelvin, or to the progress of education among the public. He regretted that the public were so ignorant of scientific subjects. Rapidly reviewing the work done in physics during the past year, he spoke of the experiments of Righi, Preston, Michelson, and J. J. Thomson, and called attention to a prediction lately published in *Nature* by Prof. G. F. Fitzgerald with regard to the probability of being able to obtain magnetic effects by passing circularly polarised light through absorptive media. After commenting upon the important position now occupied by terrestrial magnetism among the sciences, and to the advantages of the publication now known as *Science Abstracts*, Prof. Lodge said there was one event of exceptional significance to physics that had happened during the past year, an event of which science would feel the effect for centuries to come: the Government had decided to begin to establish a National Laboratory. He wished to congratulate Sir Douglas Galton, and himself, on the speedy result of their urging the matter upon the British Association. He thought the thanks of the Physical Society were due to the committee appointed by the Treasury, especially, perhaps, to Prof. Rücker, as acting-chairman of that committee, and to Mr. Chalmers, who represented the Treasury, for the way in which the work had been brought to an issue. There was much for which the present Government deserved praise during the past year; he

wished there could be added to their laurels the inauguration of a University for London. Prof. Lodge then went on to the specific subject of his address: The opacity of conducting media to light and to electric waves generally, emphasising the brilliant work of Mr. Oliver Heaviside in unifying phenomena apparently different, discussing the effect of boundaries, and dealing specially with the question, first attacked by Maxwell, of the theoretical opacity of the gold leaf. This part of the address will be published in full in the *Philosophical Magazine*.

Prof. AYRTON said, with regard to the attenuation of electric waves by the earth, that Mr. Whitehead, some months ago, came to the conclusion that when the primary and secondary coils were placed flat on the earth at a distance from one another, nearly all the energy of the primary was absorbed by the earth before reaching the secondary. The degree of absorption was so great that Mr. Whitehead had hesitated to publish his theoretical results until experiment should confirm them.

Prof. LODGE concurred with Mr. Whitehead's result. Three cases were to be considered. In the first, one horizontal coil is superposed to the other, with sea-water or some other absorbing medium between them; in this case the atmosphere at moderate distances is not excessive. But, of course, if the coils are formed of cable sheathed with iron, as in the recent experiments made by the Royal Commission, the iron itself prevents the progress of electric waves from primary to secondary. In the second case the coils are wholly in the same horizontal plane. The earth, owing to its great magnitude, behaves almost as a perfect conductor; if the coils are now near the earth, there is no normal magnetic force between them, it is all tangential. In the third case the coils are opposed to one another, both being vertical, and near to the earth. The high conductivity of the earth is here acting to the advantage of wave propagation, for the image of the primary coil is in phase with the coil itself, and the total effect is approximately doubled.

Prof. CAREY FOSTER then took the chair, and Prof. OLIVER LODGE read a paper by Mr. BENJAMIN DAVIES on "A NEW FORM OF AMPEREMETER AND VOLTMETER WITH A LONG SCALE."

These instruments are already well known, although no account of them has actually been published. They are of the moving-coil, long-range, portable type, with a very uniform scale from zero to maximum. The magnetic circuit has only one air-gap, which is generally the space between a central cylinder of iron or steel, and a concentric tube of iron, modified in various ways for facilitating the adjustment of the magnetic induction and the placing of the coil. The central cylinder is bored axially, and one side of the rectangular coil is pivoted at the top and bottom of the hole thus made. The second side of the coil moves in a circular path in the annular air-gap. Photographs of the instruments in several modified forms were exhibited.

Prof. AYRTON said the instruments appeared to be very successful; he could bear witness of their value particularly as regards the length of range. The general principle by which long-range was to be obtained on moving coil, portable instruments, was developed some 10 years ago by M. Carpentier, of Paris, who used a central magnet surrounded by a concentric hollow cylinder, with only one side of the coil in the magnetic gap between them; but it was not then a portable form of instrument, for the coil was suspended. Prof. Ayrton had himself worked in this direction in the "static station voltmeter," in that instrument there were three magnetic circuits arranged to give staticism; this was described in 1892 or 1893.

The vice-president (Prof. CAREY FOSTER) proposed a vote of thanks to the author, and the meeting adjourned until February 24th.

TROLLEY LINES APPRECIATED IN PHILADELPHIA.*

EVEN the best citizens and business men in our large cities do not always know what is to their own interests. Instances without number might be cited where trolley lines into desirable residence districts have been bitterly opposed by the property owners in the vicinity. After the service has been regularly established and the growling citizen reluctantly steps aboard the electric car, he has to admit that it is superior to anything that preceded it. After a time it would be recognised as a calamity to any community to lose such transportation facilities.

The *Philadelphia Telegraph* makes the following comments, which not only are true of Germantown, but many another large district or suburb of our cities: "The advent and development of the trolley system, after four years of successful test, has demonstrated to Germantown residents that 'the overhead trolley system, with its unsightly poles and wires,' was in reality a blessing in disguise. Germantown has been for many years peculiar in its obstinate adherence to established customs and for its opposition to innovations, no matter what ulterior benefit might accrue from their introduction.

"The opposition was so strong that a committee of citizens of recognised intelligence and ability was organised for the express purpose of fighting the scheme to the bitter end. Literature was widely circulated, wherein it was asserted that the trolleys would not only be a daily menace to the lives of men, women and children along the routes, but it was pointed out that a great depreciation in property values in the neighbourhood of the street car lines would follow, as the dangers resulting from the overhead wires and the electrical current would deter people from occupying or renting houses on streets along which the trolley cars would pass.

"The fallacy of this argument, although its supporters included men of deep learning in business and scientific lines, is easily shown in the wonderful advance in property values during the past eight years. The total value of property in Germantown in 1890 was $31,373,625, and in 1894 it increased to $37,993,781; in 1896 it was $40,118,830; in 1897, it was $44,490,970, and for the present year it will easily reach $50,000,000.

"A study of these figures shows that the advance in values since 1894, when the trolleys began running, exceeds in great proportion the increase before their introduction. Another advantage shared by Germantown with other suburbs is that of increased mail facilities. Before the days of trolley postal cars the railroads carried all postal matter intended for this suburb. The mail matter was conveyed in waggons to the stations and there were often long intermissions between trains. Now the railway post office makes the trip between the main post office and the Germantown branch in less than three-quarters of an hour, resulting in returns both in the quantity of mail delivered and received greatly in excess of former years.

"The inhabitants of the little borough along the old Germantown roads have long pursued the solitary tenor of their way and been content to follow rigidly the footsteps of their forefathers, but the clanging of the trolley bell and the hurry and bustle of the swiftly moving car have awakened them to a realisation of their ability and the possibilities of home development. The last few years have been productive of great progress in Germantown real estate, and the residents do not hesitate to give the credit for the revolution to the one-time abused, but now eagerly welcomed, trolley car."

* *Street Railway Review.*

MACHINE SHOP MANAGEMENT IN EUROPE AND AMERICA.

WRITING in the *Engineering Magazine*, Mr. H. F. L. Orcutt deals with the question of costs of manufacture, pointing out what few American writers will admit, that the average of pay in America is less than it is in England. He emphasises the fact that machine tools are attended by more or less trained labourers, whereas in Europe so-called engineers, or skilled men, are employed.

A few skilled men in America are employed to have a general oversight, but the actual running of the tool is in the hands really of a man off the floor, to use the shop expression. Of late the production of true surfaces has been more and more accomplished by grinding, the turning tool merely roughing out. In this way the lathe hand need possess little skill, for he can run two or three machines, take heavy cuts, and throw the piece to one side to be finished. The grinder then steps in, and he also can run two or three machines, and he finishes the article to limit gauges. Cheap and good work can thus be turned out, and this is not possible where work is first turned as near as may be and finished to a fit by the crude method of filing. The sub-division of labour is carried even to the grinding of the tools, which are ground all alike for the same work and by unskilled men. It is, of course, a misnomer to speak of machine attendants as engineers. The term has come down from the time when the Amalgamated Society of Engineers took its rise in opposition to the Steam Engine Makers' Society, the members of which could at one time fairly claim to be engineers, for they were as a body, men of resource and intelligence, and entirely different from the average Amalgamated Society engineer.

An attendant on a turret machine in America will earn about six shillings a day for which he will work about 10 hours. In English prices of commodities this six shillings is about equal to four shillings according to locality, and he will turn out, says our author, two to three times more work than the best lathe hand at 38s. to 45s. in Europe. American work is done by cheap labour supervised by a foreman who gets probably double wages and can keep ten machines going. The real wage of the attendant is thus the 6s. + $\frac{1}{10}$th of 12s. or, say, 7s. 6d. per day per machine.

Fitting together is reduced to a very minor operation, for where all parts are bored or ground to gauge there is small chance of misfits. Mr. Orcutt says such methods are practically unknown in Europe. Here we believe he is wrong. There is too little of it, but what there is goes one step beyond American practice, and it is the extension of the system which is necessary to cheap and good production. Both America and Germany, however, are practically free of the influence of trades unions so far as the interference with the use of machine tools is concerned, and this, it will be remembered, was at the bottom of the great strike of 1897. A special factor, however, in American practice is the raw material; American tools are comparatively flimsy, but they have equivalent material. Soft cast-iron with pickled surfaces—a particularly soft quality of steel also, make it possible to take faster cuts. Mr. Orcutt says he knows of no English or German makers of the soft class of steel delivered to American works near to size, and at $\frac{3}{4}$d. per lb. In America, also, sheet metals are rolled nearer to size and cheaper than in Europe. Finally, it is interesting to know that America's best machine makers use English steel. Evidently the use of rough and hard cast-iron has had some influence in developing and maintaining English steel at the top. But this will not prevent Americans using the best English steel and getting through a lot of work on their own softer materials.

We think that manufacturing must all end in coming into line

with the system described by Mr. Orcutt, but when it does so come into line we think, also, that the working day will be shorter. The condition of the lower grades of workers in America is not enviable, though mitigated by well arranged workshops. We cannot think that pure repetition work can be carried on by human beings, and that these should retain much humanity with long hours. Unfortunately, the cry for shorter hours has always been accompanied by refusal to recognise the only means by which shorter hours are possible. Technical education can do very little for the mass of machine tool minders, who can learn in a few weeks to move a lever or turn a knob just as nimbly as Lord Kelvin himself and to as good a result. Does it not follow that where modern manufacturing is carried out the rank and file must have some outlet or change. This should be provided for in intellectual directions. How to induce the mass of unskilled workers to become civilised is the problem before the nations. Unless this can be brought about the successful manufacturing community cannot be other than semi-savage.

MOLECULAR CONTACT.

Some recent experiments with an interferometer are described by Mr. Jas. Stevens in the *Physical Review*. He infers from the results he obtained that when a force is applied tending to cause movement of sliding of one body upon another there is developed a certain amount of movement of the surfaces one upon another before the body actually begins to move. This motion, unlike that produced when friction is overcome, is not perceptible under ordinary conditions, and on the removal of the pressure the plate returns to its original position when the force is removed. These minute movements are nearly proportional to the force applied to produce them. The law appears to hold good for the case where a plate slides on its edge for rough or smooth surfaces alike, for both dissimilar and similar surfaces of contact, and also when extra load is placed upon the moving plate.

The explanation offered is that a force insufficient to produce complete rupture between the molecules in contact cause an additional stress which pulls back, to their normal position, the bodies, when released from the external force.

The explanation to more material minds seems to be, however, that all surfaces, however polished, may be compared with a brush. Innumerable points of opposition are present. Some movement is possible between two interlocked brushes, and considerable force is necessary before these are made to let go, and until this force is exerted, the removal of any lesser force will allow of return to the normal or initial position.

The source of light in the experiments was a sodium light, in which motion through a dark or yellow space is equal to 0·25 wave lengths, and may be read to 0·025 of a wave length. The plates used were of brass, copper, steel, and cast-iron, measuring $8 \times 5 \times 1$ cm, smoothly polished on one edge and side.

The various plates weighed, according to material, from 220·5 to 272·7 grammes, and some of them showed the movement with a pull of as little as 11 grammes, and in no case did 16 grammes fail to show movement; and, excepting where one of the metals in contact was steel there was no failure to return to initial position until a pull of 36 grammes had been applied, while as much as 96 grammes was in one case applied before some permanent displacement was recorded.

The figures generally do not confirm the generally accepted idea that the friction of a body at rest is greater than that of the same body when in motion, the pull to produce actual motion exceeding that called for by the coefficient of friction in some cases and falling below in others. Further experiment would seem necessary to enable any definite conclusions to be drawn.

ELECTRIC PUMP EFFICIENCIES.

Some recent tests of single-acting outside packed plunger pumps driven by electric motors are given in the *Electrical Engineer* (N.Y.). Two series of tests were made. In the first series, with a constant voltage of 220 at 60 cycles, four heads were worked against and the efficiencies observed. In the second series a constant pressure of 100 lbs. per square inch, or 231 feet head, was maintained. In each case the maximum efficiency obtained was nearly 70 per cent. The pumps were driven through cut gearing by 65 H.P. General Electric alternating current motors at 450 revolutions, the gearing being 10 to 1, and the pumps making 45 revolutions per minute. The pumps were designed for 350 feet head and 1,250 gallons per minute.

In the second series the duty was varied by varying the speed. Head was measured by pressure gauge, and is thus independent of friction.

The following tables give the observations made. The efficiency of both pumps and motors appears very high—considerably more than should be expected in ordinary practice. The frictional resistance of the packings, and the internal work of the pump generally, are seen in their effects on the power by the very much larger efficiency under the heavier loads;—

First Series.

Pressure.	Head.	Efficiencies.			Power factor.	Amperes.
		Pump.	Motor.	Total.		
15	57·5	53·7	82·7	44·4	72·6	63
50	115	67·	86·3	57·8	83	82
100	231	76·1	88·0	67	88·2	133
152	350	80·1	86·5	69·3	85·6	198

Second Series.

Cycles.	Gallons.	Efficiencies.			Power factor.	Amperes.	Volts.
		Pump.	Motor.	Total.			
25	490	72·3	77·4	56	86·5	140	74
40	795	77·5	83·6	64·8	86·8	140	147
50	1,040	78·2	86·	67	86	140	187
60	1,350	78·	87·3	68	85	140	220

The two systems of test bring out these effects very clearly.

The combined efficiency appears very high and much above what should be counted upon except with assured conditions.

A NOTE ON THE ELECTRO-DEPOSITION OF VANADIUM.

By SHERARD COWPER-COLES.

Vanadium has not received the attention is deserves at the hands of electro-metallurgists. Vanadium oxidises slowly in the air and has a very high melting point, about 2,000° C. (equal to 3,600° F.), and is neither volatile nor fusible when heated to redness in hydrogen. The metal is not readily attacked by hydrochloric acid, either when hot or cold, neither strong nor dilute sulphuric acid act upon the metal in the cold, but when heated with strong acid the metal slowly dissolves, giving a greyish yellowish solution. Both hot and cold solutions of caustic soda are without action on the metal, but when fused with the hydroxide, hydrogen is evolved and vanadate formed. Nitric acid of all strengths oxidises the metal with violence, evolving nitrous fumes and forming a blue liquid. The Sp. G. of vanadium at 50° is 5·5, being somewhat lighter than zinc and about twice as heavy as aluminium.

Metallic vanadium made by reduction from the di-chloride in hydrogen is a light whitesh-grey coloured powder, which, under the microscope, reflects lights most powerfully and appears as a brilliant crystalline mass possessing a silver-white lustre.*

Vanadium was originally found in Mexico. Recently it has been discovered in considerable quantities near Santa Marta, in Spain. Vanadium, in the Spanish mines, is associated with lead, tellurium, gold and silver. Some of the ore contains as much as 124 lbs. of metallic vanadium to the ton.

Vanadium has also been mined on the elevated plans of the Great Chain of the Andes, where anthracite mines exist, containing two parallel inclined beds of vanadium-containing coal, from two to three metres thick and 1,004 metres long.

The present price of vanadium oxide is about £2 per lb.

Vanadium is also found in Peru, in certain anthracite coals, which, according to analysis, contain about 4·5 per cent.

An interesting paper has recently been read before the Geological Society of Washington by Mr. W. F. Hillibrand,

* Roscoe's and Schorbommer's treatise on Chemistry.

on the distribution and quantitative occurrence of vanadium in rocks of the United States.

Gore has made some experiments to deposit vanadium from its solutions, but with unsatisfactory results. The solution he used was one composed of vanadic acid, dissolved in pure dilute hydrochloric acid by means of an electric current, using a gas carbon anode and a platinum cathode. He also tried a solution of dilute sulphuric acid with pure vanadate of ammonia, and electrolysed the solution with platinum electrodes. The electrolyte turned a blueish-black colour at the cathode, and a jet-black powder of some thickness was deposited upon it.

Schicht dissolved vanadium chloride in water containing hydrochloric acid, and electrolysed the solution. Inert deposition took place in the blue liquid, the vanadium acid being merely reduced to oxide.

The author has been unable to obtain deposits of vanadium from a solution made by dissolving anhydride of vanadium in a slight excess of sodium hydroxide, but when acidified with hydrochloric acid a brilliant, white deposit was obtained, the current density per square foot being about 18 amperes, the voltage at the terminals of the cell being 2·5.

The temperature of the electrolyte was 70° to 75° C., the amount of vanadium in solution being about six ounces per gallon. Great care must be exercised to use the proper current density, otherwise the vanadium is thrown down as a black oxide.

Vanadium is found to increase the tensile strength of iron, copper and aluminium when added to those metals, also the ductility. The present use of the metal is almost exclusively confined to converting analine into fixed black dyes for indelible ink, and the colouring of glass.

THE NEW NERNST INCANDESCENCE LAMP.

The lecture delivered by **Mr. James Swinburne** on Wednesday, February 8th, at the rooms of the Society of Arts in John Street, upon the Nernst electric lamp,* has served to revive interest in this invention, and to pave the way for the company flotation which we hear is about to occur. The tone of Mr. Swinburne's lecture, and of the discussion which followed it, was extremely jubilant as regards the prospects of the new lamp; and with the one exception of Mr. Alexander Siemens, all the speakers devoted themselves to singing its praises in a high key.

In view of the approaching financial operations in connection with the English rights for the manufacture and sale of this lamp, it may be useful to point out that the directors of the Allgemeine Elektricitäts Gesellschaft, of Berlin (the company which owns the German patents, and has an option for the purchase of the remaining European patents), do not expect a revolution in lighting to follow the introduction of the Nernst lamp in Germany. The last report of the Allgemeine Company will be found in the issues of the *Elektrotechnische Zeitschrift* for December 1st and 15th last, and from this report we abstract the following opinion relative to the prospects of the Nernst lamp :—

"The lamp is about to be put upon the market in Germany. In spite of its simple appearance, it is complicated in structure. Its greater economy in current and its high illuminating power, as compared with the ordinary glow lamp, are discounted by two disadvantages. (1) It demands, in its larger sizes, a secondary heating coil, to render the magnesia rod a conductor. (2) Its temperature, when in use, is much higher than that of the ordinary glow lamp. *It is not expected that the Nernst lamp will displace to any great extent the ordinary glow lamp, on account of these disadvantages.*"

One can hardly imagine the directors of the Allgemeine speaking in this fashion of a new lamp, the German patents of which they hold, if they looked forward to realising large profits from its sale and manufacture.

The further statements made by them to the effect that the sum paid for the German patent rights *did not run into* millions (of marks), and that it is already written off in their accounts, is also of interest in view of the probable amount which will be demanded for the English patents.

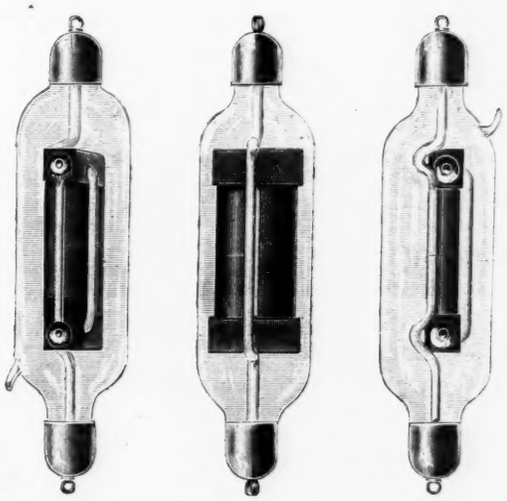
It might be as well for all interested, either financially or otherwise, in the Nernst lamp, and all intending investors in the company which is to be floated for carrying on its manufacture and sale in this country, to read the report of which we have given some abstracts above.

* See Electrical Review, February 10th, 1899.

THE KILDUCHEVESKY MEGA-TELEPHONE TRANSMITTER.

The Kilduchevesky telephone transmitter is a microphone enclosed in a vacuum or in an inert atmosphere so that powerful currents can, it is said, be used without injury to the contacts, atmospheric moisture, or other external causes of failure by which its efficiency might be impaired, being excluded. The sealing of the microphone in a high vacuum, or in an inert gas, should apparently conduce to its uniform action and longevity.

The power of the current, it is stated, may be increased to any required extent without liability of oxidation of the contacts as the latter are protected from moisture, dust, and from derangement, and no packing can, it is said, occur.



The Kilduchevesky transmitter, we are informed, was successfully tested in Russia on overhead lines over distances up to 2,000 miles (a statement which is meaningless, as the gauge of the wire is not given), and in this country by Mr. A. R. Bennett, on an artificial cable equivalent to a length of about 200 miles and having a resistance of 594·48 ohms, and a static capacity of 59·73 microfarads, the resulting K R being 35,508 ; with an ordinary double pole receiver conversation of any description could, it is said, be carried on without effort.

Though we are not inclined to accept the eulogistic conclusions which (as usual) are come to as to the future of the transmitter, there appear to be points in its construction which make it worthy of attention. The use of a microphone in a vacuum is, however, not, we believe, by any means a novelty.

REVIEW.

Railway Block Signalling. By James Pigg. London : Biggs & Co., Fleet Street. 7s. 6d.

This, as the title indicates, is a work devoted entirely to block signalling, and, as such, is, we believe, the only book specially devoted to the subject. Mr. Langdon's work, "On

the Application of Electricity to Railway Working," takes a somewhat wider range, and naturally, amongst other matter, also deals largely with this important branch—block signalling. To these two works the subject appears to be confined. We cannot congratulate Mr. Pigg on the production of much that is new. His work consists of some 387 pages, the greater portion of which, viz, from p. 137 to the end, is a reproduction, slightly modified here and there, of a series of articles which appeared in 1896 in the columns of our contemporary, the *Electrical Engineer*, from which the plates generally are also taken.

The work abounds with illustrations. They are possibly sufficient for the purpose of illustration, but they are small, have a crowded, and, in some instances, a complex appearance. There is nothing in them to inspire the reader with pleasure in the study of them. The type is clear and good reading.

The first 136 pages are devoted to Observations on the Necessity for Regulating Traffic; Historic; Object of Apparatus; Analysis of Block Signals—under which is reproduced what may be termed the standing instructions for block signalling adopted by most railways to be found in the various companies' regulations; some paragraphs on Block Indicators, Relative Importance of Indicators, Considerations on Choice of Instruments, Telegraphing of Trains, Signal Whistles, Head, Tail, and Train Signals, which completes this section of the book; and we then proceed to that portion, the main part of which appeared in the columns of our contemporary some three years since, and which treats generally of various kinds of block apparatus.

Although not new, there is yet much interesting reading in the work. The descriptive part, if occasionally somewhat laboriously expressed, is full, and to the experienced mind will, no doubt, afford food for thought. To the student, wholly unacquainted with railway working, however, we fear it will, in many parts, prove somewhat difficult. It is, to our mind, important that in all works of instruction care should be observed in the use of terms descriptive of the subject to which they are applied; for instance, why should the author in the present instance make use of the term "origination" in the sentence "whilst the origination of the main principle may be credited to," &c. Why should he object to the word *origin*, surely it would better harmonise with, and have more correctly represented what he desired to say. Another instance in point is that at p. 30, and elsewhere where reference is made to the *sending* and *receiving* end of a block section, the *sending signalman*, &c. The terms are not those generally recognised, and are likely to lead to confusion in the minds of those who are in a measure strangers to the subject. Is not the sending signalman also the receiving signalman? Of course, we may divide the man into his duties and make of him for the purpose of his individual actions, at one instant a "sending signalman," and at another a "receiving signalman." The introduction of such terms, even for the sake of novelty, are not desirable, nor are they in this instance at all happy.

Interest may attach to the date on which the block or a form of block, was introduced on various bits of railway, but it is doubtful if much of this information, which is to be found under the heading "Historic," is of service, except perhaps in the archives of the railway companies to whom the section of line referred to belongs. We also question whether the author is correct in, at p. 7, attributing the introduction of the use of electric semaphore signals to the South-Eastern Company in 1851. We are under the impression this was not done for quite 10 years later, probably about 1863. Again, it is stated that in 1848 a three-wire "block" was in operation on the Manchester, Buxton and Midlands Junction Railway, and that in 1849 the Midland Railway Company had a "three-wire block circuit" in use between Desford and Bagsworth. In this we think there must be some error, for we believe the *three*-wire block was not introduced on any portion of the Midland system until about 1867. A block system was in use on the Desford and Bagsworth incline, but it was not a three-wire system.

We are not quite sure that we are with our author, where, at p. 9, he concludes that because where the block wires were cut by the guard in order to warn the signalman of some mishap on the line that the indicator "Line blocked" was established as an emergency signal. The cutting of these wires was not so frequent as to call for a signal purely applicable to such a transaction. And as a matter of fact this provision for severing the wires, as was explained in a previous work, was very soon abandoned. The indicator would, however, be a proper one for the purpose of telling the signalman that the line was not clear as well as for inspiring caution in case of failure of the instrument. Nor do we agree (p. 78) that the signal "Train on line" is a subsidiary signal. It is to our mind one of the most absolute and important signals employed in the operation of block working. At p. 90 the advantages of the single and three-wire systems in relation to battery power and line or other failures are debated. The teaching is not so clear as we should like to see it. A student in reading it would be somewhat in doubt whether he ought to use a three-wire or a one-wire system, and might also feel somewhat perplexed in determining whether it would be better to work all the instruments off one set of batteries or to devote a battery to each. The term "transient," too, which we meet with frequently throughout the book, does not commend itself as well chosen. Apparatus which is not worked by what are regarded as permanent currents, are usually spoken of as being operated by *momentary* currents. The latter term defines, to our mind, the condition more correctly, and as it is the generally accepted term in relation to the subject, we are sorry to see in this, as in other instances, apparently a desire to introduce something new. The introduction of new terms often tends to mystify the student. Those currents which in block working are regarded as *permanent*, are not, of course, permanent in the full sense of the word; although not *so* transitory as the momentary current, they are quite as much transitory as they are permanent.

At page 92, in dealing with *disturbance of instruments*, the author proceeds to point out that, in consequence of the generally lighter construction and greater sensitiveness of a certain class of block indicators, they are more subject to the effects of *earth currents* or *magnetic storms*, and suggests that the remedy lies in making the apparatus less sensitive. Surely, if this were a good solution, it would ere this have been adopted. The effect of earth currents is well known. They are, as the author states, always present; but it is only occasionally they are of such a character as to affect the block signals. To render the block apparatus less sensitive would naturally lead to an increase of battery power. Is it worth this? Railway companies know best. The signalling regulations make provision against irregularities arising from such a source; and we should not forget that, however the vitality of the instrument may be reduced, there are occasionally earth currents of such power as to affect them, and to affect even that class of instrument—those worked by momentary currents—which the author appears to consider beyond their power. We scarcely follow the reference to *magnetic storms*. We are uncertain if this applies to lightning storms. So far as we understand the question, electrical apparatus of this character is liable to be affected by lightning, and by any disturbance of the electrical potential of the earth. This disturbance, which arises from one part of the earth's crust being at a higher potential than that at other points, occasions the passage of currents from one point to the other, and where the telegraph wires are connected to the earth, and those wires lay in the direction in which these currents are travelling, they avail themselves of the wires. These are termed earth currrents, and when they are unusually violent they are sometimes referred to as "electric storms," but they have precisely the same origin, the only difference is that of degree. The only way to avoid them is to avoid all connection with the earth, but the author does not say so. In like manner, when speaking of the difficulties at times experienced in obtaining a good "earth," he omits to tell his reader that he may find comfort in the provision of a "return wire."

Turning to Block Working, p. 140, we find that "block working may, for convenience, be divided into two main parts, 'absolute' and 'permissive.' Absolute block may again be divided into 'double line' and 'single line' working." Here we again take exception to the terms used. *Permissive* working is a thing of the past. Under the Railway Regulation Act of 1889 railways have now to be worked, and have for some time past been worked, under the block system—not a permissive but an absolute block—a block which admits of but one train or engine upon one pair of rails within one section at a time. In days gone by the permissive block, as it was termed, did admit of more than one train travelling in

the same direction being upon the same line of metals and within the same section. It was a vicious system and cannot be too strongly condemned. We should rather say that the terms under which block signalling might more properly be divided are *affirmative* and *positive*. The *affirmative* is that under which most railways are now worked, and which requires that the signalman shall *obtain permission* from the signalman at the distant end of the section before sending the train into it. He asks "may I send you a train," and, if the section is ready to receive it he is told by the movement of the block indicator "Yes, you may." This is the *affirmative* system. The only other system is that which exhibits the line blocked or train on line signal during the time, and only during the time the train is traversing the section, or it is fouled by some other cause. This is the *positive* system.

Passing on we notice that the text (p. 163) does not appear to accord with the illustration. The latter shows line blocked, and not line clear, for an up train.

There are other points to which the attention of the author might be drawn with a view to their adjustment in any future edition of his work, but this criticism has already greatly exceeded the space which it is in our power to afford such notices generally; but there are one or two more cases to which we should like to direct his attention. At p. 241, in speaking of the "staff and ticket," he observes that the ticket is a "supplementary authority for the driver to proceed, which is understood to be available for use only when the staff for the section to be entered is in possession of the signalman at the *entrance* to the section." We would like to ask if it is not a standing rule that when a "ticket" is presented to the driver, the "staff" shall also be shown to him, and to the guard also, in order that he, the driver, may be assured the staff is at that end of the section? We think this is so, and it is evidently a very necessary and a very important regulation. Yet the text admits of the reader assuming that the presentation of the ticket by itself is the all-powerful talisman. A book which has for its object the dissemination of knowledge on so important a subject, or which, perhaps, aims at teaching those who may have to deal with the movement of trains, the manner in which traffic may be protected, should handle such points in a perfectly clear and unambiguous manner, so that no doubt may linger, and no misconception exist in the mind of the reader. As we have stated in the early portion of these remarks, the book contains much worth reading, but it is more suitable for the reader who already has experience of railway working than for the student.

The illustration on p. 299 appears to be inaccurate. The battery is arranged in the manner now so generally adopted for electric repeaters. The positive to line forms, say, the ON signal, the negative the OFF signal, and the absence of the current provides for what the author denominates the "out of order" signal. The indications on the instrument do not accord. The "out of order" signal is indicated by a deflection of the needle to the right; the vertical position is devoted to the ON signal. The instrument is that of an ordinary vertical galvanometer. Why, we should like to know, should the vertical signal be dubbed an "out of order" signal? The employment of such a term must lead to confusion. We question if it is not better to leave it unappropriated as representing the intervening space between the ON and the OFF position. The chief thing to insure is, that a signal actually stands at danger when the signalman assumes he has so placed it. If it is not fully at danger, a driver is justified in passing it, and as has, we think, been pointed out in a standard work on the subject, it is not permissible that, when indicating this signal, the semaphore arm should deviate from the horizontal more than 3°—that is, any deviation beyond this removes it from the ON region. These important points should not be lost sight of in a work of this character.

It is strongly urged that sufficient has not been done for the engine driver; that he is left to look out for himself; he has nothing beyond the signals on the line to guide him, and these are not always in view, &c. In this we do not concur. The signals—visual or aural—are for his guidance, and to replace these by anything on the engine, unless it were perfectly infallible, would be to remove responsibility from the driver. It is argued in another portion of the book that the driver is the man who should call out, or order out, the fog-men, and not the stationmaster or signalman. Very little consideration will convince one of the impracticability of such a course. Again, it is urged that uniformity in the character of the block signals is desirable. *Qui bono!* It might be of advantage if there were an interchange of staff, between the various railway companies, but there is no such interchange. With regard to uniformity of the *code* of signals, this has been settled, so far as it can be, long since by committees sitting at the Railway Clearing House. There is now a perfectly uniform Bell code, and, so far as is possible, the instructions for the operation of the block instruments are made to conform.

We notice that although the telephone has become so necessary in working the traffic of a railway, but a very few lines are devoted to it, and those refer to its combination with the block bell. In this, as in practically all the useful adjuncts referred to, their origin, or those by whom they were invented or introduced, is not mentioned; and although it is only reasonable to assume that some information has been gathered from other works devoted to kindred subjects, the only reference to the authors of such works is that to Mr. Clement E. Stretton.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1899.

Compiled expressly for this journal by **W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham,** *to whom all inquiries should be addressed.*

2,044. "A method of varying the electromotive force of and consequently the current in a circuit carrying an alternating current of electricity." J. Hutton. Dated January 30th.

2,068. "An improvement in conveying electric current to portable fittings for lighting or to motors and other electrical purposes." F. C. Melhado. Dated January 30th.

2,074. "An improved electric arc lamp." C. Eschwei. Dated January 30th.

2,104. "Improvements in electrically illuminated signs or advertisements." J. Hunter. Dated January 30th.

2,118. "Improvements in or connected with the manufacture of electrical cable or conductor conduits." A. Musker. Dated January 31st.

2,129. "Improvements in or relating to means for preventing the creeping of acids or other deleterious matter in electrical apparatus." J. T. Niblett and M. Sutherland. Dated January 31st.

2,130. "Improvements in safety devices for electro-magnetic circuits." B. Thomas. Dated January 31st.

2,131. "An improved means or apparatus for reducing or extinguishing the electric arc formed on breaking electrical circuits." R. Acock. Dated January 31st.

2,144. "Improvements in and relating to primary batteries." T. Hefferman. Dated January 31st.

2,165. "An improved cover of electrical cells." L. Fiedler and E. Jackel. Dated January 31st.

2,166. "An elastic support for electrodes." L. Feidler and E. Jackel. Dated January 31st.

2,170. "Electric heating apparatus." A. R. Leask. Dated January 31st.

2,171. "Improvements in electric heaters." A. R. Leask. Dated January 31st.

2,174. "An improvement in commutator brushes for electrical machines." Siemens Bros. & Co., Limited, and A. Siemens. Dated January 31st. (*Complete.*)

2,175. "Appliance for automatically regulating the frictional pressure on the rails of the driving wheels of electrically propelled vehicles." Siemens Bros. & Co., Limited. (Siemens & Halske Aktien Gesellschaft, Germany.) Dated January 31st. (*Complete.*)

2,176. "Safety appliances in connection with overhead or exposed conductors of electrical railways and tramways." Siemens Bros. and Co., Limited. (Siemens & Halske Aktien Gesellschaft, Germany.) Dated January 31st.

2,177. "Method of supplying electrical energy to motor vehicles from two overhead conductors." Siemens Bros. & Co., Limited. (Siemens & Halske Aktien Gesellschaft, Germany.) Dated January 31st.

2,218. "Improvements in electrical cut-outs." M. Schmidt. Dated January 31st. (*Complete.*)

2,246. "Improvements in electrical gas lighting appliances." J. F. Bennett and W. Appleyard. Dated February 1st.

2,268. "A new or improved cord grip for electric lampholders, fittings, and the like." F. Brown. Dated February 1st.

2,273. "Improvements in electrc-therapeutics." C. A. DAY. (G. O'Neill and J. Rooney, United States.) Dated February 1st.

2,280. "Improvements in electric arc lamps." E. FRISCHAUER and A. O. SIMONNIER. Dated February 1st.

2,288. "Improvements in or relating to accumulator plates." P. F. RIBBE. Dated February 1st. (*Complete.*)

2,299. "Improvements in the manufacture of electric accumulators or secondary batteries." J. G. HATHAWAY. Dated February 1st. (*Complete.*)

2,303. "Improvements in and relating to electrical conductors." W. A. PHILLIPS. Dated February 1st.

2,304. "A new or improved method and means for fire-proofing insulated wires and cables." W. A. PHILLIPS. Dated February 1st.

2,305. "Improvements in means for covering wires and cables." W. A. PHILLIPS. Dated February 1st.

2,350. "A new or improved method of connecting electric telephonic apparatus as a system." F. G. BELL and M. BYNG. Dated February 2nd.

2,358. "Improved arrangement for exciting the magnets of dynamo-electric machines." M. DERI. Dated February 2nd. (*Complete.*)

2,362. "Improvements in apparatus for regulating vehicles propelled by electric motors." H. F. JOEL. Dated February 2nd.

2,369. "Improvements in the manufacture of electrodes and division plates for secondary batteries." W. M. MCDOUGALL. Dated February 2nd.

2,377. "Improvements in electric igniting devices." H. B. REES. Dated February 2nd.

2,386. "Improvements in apparatus for use in connection with wireless telegraphy." M. J. NEHEMIAS and H. F. A. SCHRÖDER. Dated February 2nd. (*Complete.*)

2,396. "Improvements in and relating to the fixing of insulators for carrying electric line wires." H. FLEISCHHACKER. Dated February 2nd. (*Complete.*)

2,422. "An automatic guard or safety appliance for use on electric, cable, or other tramcars, motor cars, and the like." J. LENNIE. Dated February 3rd.

2,425. "Improvements in and connected with the trolleys of electric railways." A. HARTLEY and J. RHODES. Dated February 3rd.

2,428. "Improvements in electric switches." H. C. GOVER and J. M. HUISMAN. Dated February 3rd.

2,454. "A new or improved method of and means for electrically connecting railway carriage vans and locomotive for communication or signalling purposes." D. CUNNINGHAM. Dated February 3rd.

2,482. "Improvements in means or apparatus for recording and repeating and re-transmitting Morse characters for use with telegraphic instruments." C. STEVENS, C. C. VYLE, and W. MILNER. Dated February 3rd.

2,507. "Improvements in and in connection with primary battery electric generator." H. T. HARRISON. Dated February 3rd.

2,525. "Improvements in or connected with electric batteries." J. L. DOBELL. Dated February 4th.

2,527. "Improvements in safety electric fuses for high voltage circuits." O. MOON and J. A. LOUGHLIN. Dated February 4th.

2,575. "Improvements in apparatus for taking projecting or inspecting series of photographs." W. BRITAIN, jun. Dated February 4th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. THOMPSON & Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, *price, post free*, 9d. (*in stamps*).

1897.

73. "Improvements in apparatus for the manufacture of metallic pipes and rods, and for covering electric telegraph and telephone cables and wires." A. WYLIE. Dated January 1st, 1897. The invention relates to a lead press for producing pipes or rods by squirting, or for armouring electric conductors, and is an improvement on Specification No. 17,420 (1888). The application to the last purpose is shown. A hollow block in which there are passages for the circulation of a cooling fluid, is supported on the ram of an hydraulic press. The block contains a die holder which is kept in place by a smaller ram. The die which covers the cable, and the core through which it passes, screw adjustably into the dye holder, and on the top of the block a container for lead rests. The contents of the container are kept at a suitable temperature by fluid circulating inside a jacket. The container and die are forced upwards against a fixed plunger. 2 claims.

265. "Electrical indicating railroad signalling." G. GRIFFITH. Dated January 5th, 1897. Indicators and repeaters, signal; contacts, electric. Relates to means for indicating to the driver the position of the ordinary signals, means being also provided for giving a repeating signal in the signal cabin. A visual indicator and a bell on the engine are connected to an insulated brush, which is adapted to make contact with a series of insulated conductors fixed on the permanent way, a conductor being provided for each ordinary signal. Each conductor is connected by a lead through a visual indicator and bell in the signal cabin to a reversing switch controlled by the lever which operates the ordinary signal, the return lead connecting the reversing switch to the rails. When the brush makes contact with the conductor, a circuit is completed through the bells and indicators, the latter of which are operated to the position of "safety" or "danger" according to the position of the ordinary signal. 2 claims.

666. "Improvements in couplings for incandescent electric lamps." H. A. MAYOR, W. A. COULSON, and S. MAYOR. Dated January 9th, 1897. *Incandescent lamps* are supported on pendants and brackets containing concentric conductors, by holders such as that illustrated. The lamp terminals are a screw cap and a central contact piece. The pendant also terminates in a screw connected to the outer conductor and a central contact on the inner. The lampholder consists of a screw-threaded ring which is placed on the screw, and carries a brass or other spring into which the lamp cap is screwed. A ring may be provided with an outside screw-thread and nut to carry a shade. 4 claims.

964. "Improvements in reflectors for electric lamps and in supports for the same." F. A. ANDERSON and W. G. WATERMAN. Dated January 13th, 1897. *Reflectors and Holders therefor.*—Reflectors for electric incandescent lamps are made with apertures through which the upper parts of the bulbs project. The reflectors may be of small size and used under ordinary shades. They may be supported adjustably on an ordinary lampholder, either by tubes sliding stiffly on pins or wires on a ring, or by links connected by clamping screws. Or they may be supported by springs, or rest directly on the upper part of the lamp bulb. 2 claims.

1,430. "Improvements in and connected with electrical storage batteries." E. J. WADE. Dated January 19th, 1897. The plates are made up of strips formed of pleated or crimped wires, or flattened helices of wire, or a plate notched. A number of these strips are placed crossways and united at top and bottom by metal bars. 4 claims.

1,535. "Improvements in the electric precipitation of gold and silver from their cyanide solutions." A. JAMES. Dated January 20th, 1897. In electro-precipitating gold or silver, or gold and silver from cyanide solutions, anodes of lead and cathodes of lead or aluminium are used. 3 claims.

1,572. "Improvements in electrolytes for the deposition of zinc and for use in secondary batteries." H. LEITNER. Dated January 20th, 1897. Refers to specification No. 24,473, A.D. 1896, and relates to improvements in the electrolyte therein described for depositing a coherent layer of zinc on a lead or other base, for use as a secondary battery electrode. The electrolyte is prepared as follows:—(*a*) 50 parts of concentrated zinc sulphate solution, 10 parts of pure sulphuric acid, 10 parts of concentrated manganese sulphate solution, and 30 parts of concentrated ammonia or other alum solution containing some zinc sulphate in solution; or (*b*) nine parts of water to one of concentrated sulphuric acid and one of concentrated manganese sulphate solution, the resulting solution being saturated with crystals of zinc sulphate and alum (preferably ammonia alum). Either of these electrolytes can be used to form the plate, or in the accumulator itself. In the latter case, the positive electrode is a porous lead peroxide plate. 2 claims.

1,591. "An improvement in incandescent electric lamps." H. C. GOVER, J. M. MOFFAT and W. E. BARRAS. Dated January 20th, 1897. Relates to incandescent lamps. Bulbs are made partly of opalescent glass or partly coated with such glass, such parts forming reflectors. 2 claims.

2,470. "Improvements in electroplating apparatus." R. J. MARKS. Dated January 29th, 1897. (Date applied for under Patents, &c., Act, 1883, Section 103, October 12th, 1896, being date of application in the United States.) A work holder for use in electroplating, is formed of a non-conducting frame, as of wood, connected by non-conducting bars between which are secured the permeable conducting sections upon which the work is placed. A cover, preferably of an open frame and wire netting, is provided for convenience when shaking up the contents. The sections are connected to the metallic supporting hanger carried from the conductor, while the sections are connected to the hanger carried from the same conductor. 5 claims.

2,721. "Improvements in, and relating to, electric motors." T. VAN H. OBELT. Dated February 2nd, 1897. Electric motors for driving phonographs and similar instruments are provided with a governor on the main shaft or on a worm-driven countershaft. The governor consists of a fixed disc and a sliding disc connected by two or more plate springs having weights at their centres. The sliding disc is mounted on a sleeve, the inner end of which can bear against a cross pin protruding from a slot in the axle, which is hollow. The pin is attached to a sliding rod contained by the hollow axle, the outer end of the rod carrying a disc against which bears an adjustable braking screw. The motor shaft is mounted by end bearings in a frame, and is provided with a suitable driving pulley. 3 claims.

3,288. "Improvements in electric furnaces." R. C. CONTARDS. Dated February 8th, 1897. An arc furnace is built of firebrick or the like, with parts near the arc of more refractory material, as plumbago; or these parts may be hollowed and cooled with a circulating fluid. Air is admitted through openings above these parts to burn the combustible gases produced by the arcs, and thus heat the materials introduced by openings. The gaseous products are drawn off through the openings. In the form shown, the electrodes are in aligned pairs, crossing the furnace. Each pair is protected by an angular or curved part. The fluid products pass through openings below the electrodes into a space, from which metal and slag can be tapped. In a simpler form only two pairs of carbons are used, under one protecting part, and the roof built up of overlapping horizontal slabs, on a movable metal base. In another form, the furnace is circular, and pairs of parallel carbons project radially into it, under a suitably modified protecting part. 6 claims.